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A REVIEW ON DIGESTIVE STIMULANT HERBS USED FOR IRRITABLE BOWEL SYNDROME

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ABSTRACT

Irritable Bowel Syndrome (IBS) is a chronic digestive illness marked by stomach discomfort, bloating, diarrhea, and periods of constipation. It. Treatment is focused on symptom management based on the many processes in the aetiology. Several patients have rotated to alternative and complementary medicine due to the extended duration of their conditions, inadequacy of established therapies, financial load on patients, and pharmacologic consequences. Acupuncture, hypnosis, yoga, cognitive behavior as well as herbal medicine are all alternative and complementary therapies for gastrointestinal syndrome. As opposed to organic GI illnesses, IBS has traditionally been regarded as a functional condition of the gastrointestinal (GI) tract (like IBD). Herbal medications can have both helpful and negative effects on the digestive tract. The goal of this IBS review is to look at how to use digestive herbs to help with digestion. Chili pepper, ginger, black cumin, ajwain, fennel, coriander, menthe, cinnamon, fenugreek, thyme, nutmeg, and curcumin are among the plants used. In many underdeveloped nations, herbal medicines constitute an essential element of the healthcare system. Some plants have negative side effects, while others interact with prescription medications. Herbal treatments, on the other hand, may be beneficial for the treatment of IBS.

Keywords: irritable bowel syndrome, digestive stimulant, medicinal herbs, gastrointestinal action, alternative and complementary medicines

INTRODUCTION

Irritable bowel syndrome (IBS) is a functional gastrointestinal illness by stomach bloating, pain, and bowel problems. Or Irritable bowel syndrome (IBS) is a collection of symptoms that assumable your digestive tract. It is a common yet inconvenient gastrointestinal (GI) condition. Excess gas, stomach discomfort, and cramping are common symptoms of IBS. IBS is also known as irritable bowel syndrome, spastic colon syndrome, or irritable colon syndrome, as well as nervous stomach syndrome, because symptoms commonly occur while you're experiencing mental anguish, tension, or worry. it affects more women than males (ratio of 2:1), According to Asian studies, more industrial nations like Singapore (8.6%) and Japan (9.8%) have a greater incidence of IBS than India, which has the lowest prevalence (4.2 percent) **[1, 2]**. Irritable bowel syndrome (IBS) stands out among the numerous non-communicable chronic illnesses because of its global incidence, the vast range of symptoms, a wide range of etiologies, difficult diagnoses, and significant economic burden. In contrast to organic GI illnesses (such as inflammatory bowel disease, IBD), IBS has traditionally been regarded as a functional condition of the gastrointestinal (GI) tract. **[3]** At any given moment, the illness affects around 5% and 10% of other healthy persons and, in most cases, follows a relapsing as well as remitting pattern. Acute gastrointestinal infection is the most well-known risk factor, although irritable bowel syndrome is also more prevalent among patients with psychosocial comorbidity and young grown women than that of the public at large **[4]**. IBS involves diarrhea-predominant IBS (IBS-D). Most of your poop is loose and watery. Constipation-predominant IBS (IBS-C) Most of your poop is hard and lumpy, and if you have IBS with major abnormal bowel habits (mixed diarrhoea or constipation), you will have both hard and lumpy bowel motions as well as loose and watery ones. Organic disorders that might resemble IBS (i.e. IBD, celiac disease, sensitivity to carbs such as fructose and lactose, neoplasia, micro colitis etc.) must be ruled out because the signs that describe IBS are not unique. Irritable bowel is unexplained fever and symptoms that appear beyond the age of 50 **[5]**. After traditional treatments failed to provide significant comfort, an increase the number of patients have resorted to complementary and alternative treatments. Alternative therapy use was earlier reported to be higher for IBS than for other gastrointestinal illnesses, with up to 40% of

IBS patients consulting an alternative practitioner if therapeutic approaches failed **[6]**. Complementary and alternative medicine, as well as herbs and plants, could be used to treat irritable bowel syndrome. Studies involving alternative therapies other than herbs, as well as functional bowel syndrome reviews **[7]**. As a result, herbal medication is more commonly employed than alternative and complementary medicine in the treatment for irritable bowel syndrome.

DIGESTIVE STIMULANT HERBS

Chili pepper:

Chili peppers originate in Mexico's Columbian Exchange. The chili pepper has expanded over the globe. Pepper (Capsicum spp.) is a member of the Solanaceae family of plants. Pepper (Capsicum spp.) is the oldest and most widely used crops. There are nearly 200 species of capsicum, and the fruits vary greatly in taste and aromatic intensity. *C. frutescens, C. baccatum*, *C. pubescens*, *Capsicum annuum*, and *C. chinense* are 5 different varieties of Capsicum. Dry matter, total fat, proteins, carbs, dietary fibre, and vitamin C are all present in *C. annuum* fruits. Protein, glucose, capcaicin, vitamin C, and dietary fibres are all included in the Capsicum annuum fruit's chemical make-up **[8]**. Capsaicin, a hot-producing chemical found in chilli peppers, is used as an analgesic in external dermal patches, ointments, and nasal sprays to reduce pain. Because it is the most frequent of the seven capsaicinoids, followed by dihydrocapsaicin, the capsaicinoids are usually referred to as capsaicin **[8]**. Red pepper's well-known digestive stimulating activity, or even its active ingredient capsaicin, can be thought of as being mediated in two ways...

(I) stimulating the liver in to produce more bile acid-rich bile, and (ii) stimulating pancreatic and digestive enzyme activity involved in digestion, resulting in a significantly reducting in the time it takes for food to transit through the gastrointestinal (GI) system. Capsaicin has been researched to see if it allows for an effective digestive process of dietary lipids after high consumption of fat because it stimulates bile production with increased amounts of bile acid, which plays a vital role in the digestion for dietary fats. When the nerve centres are triggered by the sense of smell as well as the presence of pungent principle such as capsaicin, they can accelerate salivary secretion and gastric juice flow, aiding digestion. The digestive stimulatory function of hot capsicum is thought to be linked to the activation of bile and saliva production and the activity of digestive enzymes in the intestine and pancreas. It’s also increases

salivary amylase activity, which aids in the digestion of starch as well as mucocutaneous synthesis in the mouth, throat, and gastrointestinal system. Hot Capsicum has been shown in animal experiments to improve the fat digestion process in high-fat-fed animals by stimulating the liver to release bile rich in bile acids **[9]**. Spices' digestive stimulant effect is most likely due to stimulation of the liver's production and secretion of bile acid-rich bile, which is crucial for fat digestion and absorption. Capsaicin, a low-cholesterol spice, boosted the liver's production of bile acid and its flow in the bile. The effects of dietary intake as well as a single dosage of the effects of capsaicin on pancreatic and small intestinal mucosa terminal digesting enzymes have been demonstrated. Capsaicin consumption significantly boosted pancreatic enzymatic activity. A single oral dosage of capsaicin had little influence on pancreatic lipase activation, in contrast to prolonged usage. Dietary capsaicin (72%) and single-dose capsaicin treatment both increased pancreatic amylase activity. When added to the diet, capsaicin increased trypsin activity by over 100 percent. Capsaicin-fed animals had considerably greater chymotrypsin levels. When the spice component was given as a single oral dose, no similar effect on protease activity was seen. Capsaicin significantly increased intestinal lipase activity. Similarly, eating capsaicin boosted intestinal amylase activity considerably. The activities of intestinal disaccharidases were moderately increased by dietary capsaicin **[10]**.

Ginger:

The ginger root, used as a part of the rhizome *Zingiber officinale* (family Zingiberaceae), commonly called as ginger, is used in kitchen spices and also possesses a numerous of healthy benefits **[11]**. Medicinal herbs include chemicals that promote appetite and digestive efficiencies, acting as digestive stimulants through bile production and enhanced pancreatic enzyme activity, resulting in a faster rate of development. Digestive stimulants found in ginger include thiol protease, gingerol, gingiber, and camphene, which boost trypsin activity. The lowest trypsin activity was seen when extra ginger and garlic were consumed by Onchorhynchus mykiss at doses of 0.5 and 1 g/100 g meal. Ginger contains active chemicals that increase digestive tract activity, reducing the time food spends moving through the digestive tract and allowing it to be discharged rapidly. Active chemicals in ginger, on the other hand, activate the autonomous nervous system (ANS), which has a beneficial impact on

cholecystokinin action in the gut and pancreas, resulting in enhanced release of amylase into the GI. Ginger's effect on boosting bacterial growth in the digestive system, which promotes amylase activity, suggests that amylase action is affected more than proteases like trypsin. The amount of trypsin-digested proteins in the gut is larger in the treatments than in the control group, suggesting that the elevated levels of alkaline phosphatase, which is important in the hydrolysis of phosphorylated proteins, are realistic **[12]**.

Black cumin:

Cumin seeds (*Cuminum cyminum* L.) are extensively used as a spice because of their unique scent, but they are also employed in ancient medicine to cure a number of ailments. Cumin seeds are a part of the Apiaceae family, which includes parsley. It is native to the Eastern Mediterranean and Southeast Asia. Black cumin is used in herbal medicine to treat a variety of ailments. The effectiveness of the primary ingredient, thymoquinine (TQ), essential oil, seed oil **[13]**, Cumin extracts prepared with hot water and NaCl increased enzymatic activity such as amylase, lipase, and phytase significantly. When compared to the essential oil, those extracts showed extremely significant antiradical activity **[14]**. Black cumin seed has long been used to treat gastrointestinal problems. In acetylsalicylic acid-treated rats, the extracts of the seeds were found to have an anti-ulcer effect by lowering the amount of acid in the gastric-juice. The antiulcer effect of the alcoholic extract was tested in rats using two models: pyloric ligation with aspirin-induced gastric ulcer were used as models. Its traditional usage in diarrhoea lowered the volume(ml) of stomach acid output, ulcer index, total acidity, free acidity considerably Furthermore, seed oil has been demonstrated to have a hepatoprotective impact in various liver damage models **[15]**.

Ajwain:

Ajwain, also known as *Trachyspermum ammi* (L.) Sprague is a fragrant, annual, and herbaceous plant of the family Apiaceae. It has its origins in Persia's eastern regions as well as India.The chemical contents of ajwain seeds included thymol, p-cymene, P, Fe, B vitamins, essential oil, Ca, limonene, a-pinene, as well as c-terpene **[16]** the plant was once used as a digestive stimulant by traditional healers. Ajwain has now been shown to boost stomach acid production, bile acid secretion, and digestive enzyme activity. It may also shorten the time between meals. Ajwain's enzyme modulatory action increased the efficacy of pancreatic lipase and amylase, possibly supporting the

digestive stimulating function **[17]**. Ajwain increases stomach acid output by roughly four times. In vivo, adding ajwain to the diet lowered meal movement time while also increasing the action of digestive enzymes, resulting in increased bile acid **[18]**. For acidity, atonic dyspepsia, and flatulence, a mixture of oil and seeds of Ajwain coupled with soda makes a good cure. In the initial stages of cholera, using oil and de-ionised water from the beans, known as Arqe Ajwain (omum water), in dosages of 1-2 ounces, can help to control vomiting and purging. Flatulence To produce an effective carminative, it is blended with other aromatics such as eucalyptus, peppermint, gaultheria, and others **[19]** .

Fennel:

Fennel, also known as *Foeniculum vulgare* Mill. (Apiaceae family), is a widely distributed every year or perennial plant with a fragrant odour. It is endemic to the Mediterranean area and southern Europe. The plant has a wide range of culinary and medicinal uses. Monoterpenids, fatty acids, coumarins, Essential oils, phenylpropanoids, and sesquiterpenes are among the chemical elements of fennel (seed). cardiac glycosides, tannins, saponins, Triterpenoids, flavonoids, and other chemicals are also present. Safrol, estragol (methyl-chavicol), p-cymen, camphene, Anethol, alpha-pinene, betamyrcene, alpha-phellandrine, fenchone, beta-pinene, and limonene are all present in the essential oil of the most significant fennel variety **[20]**. When fennel is known to boost a healthy digestion and appetite, meal transit time was significantly reduced when certain common dietary spices were added to the diet. Fennel has a considerable quantity of anethole, which is present all through the plant but is largely concentrated in the seeds. This chemical is responsible for fennel's digestive and demulcent properties, as well as its pleasant flavour, which makes it a tasty vegetable to add to meals. Vegetable charcoal is renowned for its capacity to absorb gases and liquids quickly in the intestines, as well as maintaining healthy intestinal flora that aids digestion. Encapsulate vegetable-based charcoal with fennel as a flavoring, which is commercially available. The impact of essential oils on intestinal foamy may be connected. Cinnamon, caraway oils, Peppermint, orange, fennel, and dill have been demonstrated to be particularly effective in interrupting gastro-intestinal effervescence as a result of stomach and intestinal secretion stimulation **[21]**.

Coriander:

Coriander (*Coriandrum sativum*), often known as Chinese parsley or cilantro, is a feathery annual herbaceous plant in the Apiaceae family that is used as a herb and spice. The plant is native to the Aegean and Middle Eastern areas, although it is commonly cultivated for culinary purposes all over the world. Its seeds and dried fruits, which are commonly known as coriander [**22]**, In traditional medicine, coriander was used in therapeutic formulations to treat stomach problems. The whole plant of coriander is used as a traditional medicine in Pakistan's northeastern region to cure bloating, dysentery, diarrhoea, cough, stomach ailments, jaundice, and vomiting. Coriander is also utilised in Indian medication used to treat digestive, respiratory, and urinary system diseases since it possesses diaphoretic, diuretic, carminative, and stimulating properties. An infusion of beans is used as a gastrointestinal and carminative agent as well as to increase appetite. The action of digestive stimulants may be mediated by stimulating the liver to release bile rich in bile acids and stimulating enzyme activity include indigestion, both pancreatic and intestinal. The total digestive process is expedited as a result of this secretion of bile production and the activity of enzyme, resulting in a considerable decrease in the time it takes for food to pass through the gastrointestinal system [**23**].

Mentha:

Peppermint, *Mentha piperita* L. (family Lamiaceae), is an annual herbs native to Europe that has become naturalised in the northern United States and Canada, as well as grown in many other countries. M. aquatica L. is a hybrid of water mint (*M. spicata* L.) and mint (*M. spicata* L.) **[24]**. *M. piperita, M. rotundifolia, M. suaveolens, M. aquatica, M. longifolia, M. pulegium, M. arvensis*, and *M. spicata* are some of the most common Mentha species [**25]**. *M. aquatica* L. (Water Mint): The leaves are used to make a tea that is traditionally used to cure fevers, headaches, digestive problems, and other minor maladies. The plant is traditionally used in South Africa to treat colds, respiratory ailments, and ward off bad spirits. (Corn mint or wild mint), laryngitis, neuralgia, indigestion, rheumatic pain, colds, bronchitis and toothache are all treated with this herb. It can also be used to treat earaches, tumours, and certain skin disorders. It is used as a carminative, nasal decongestant, and for the treatment of stomach and skin problems in traditional medicine. *Cervina L*. The herb, along with *M. pulegium*, is essentials oil, has economic application in food preservation and has been

used for its therapeutic effects in the prevention of different stomach diseases and respiratory tract irritation. It is traditionally used to flavour foods and in masses medicine in Portugal, where it is used as a treatment to prevent various gastrointestinal illnesses and respiratory tract inflammations.

Mentha citrata L. is a plant that belongs to the mint family (lemon-mint, lavender mint, or Bergamot mint). parasites Stomachaches, nausea, and other digestive diseases, as well as respiratory infections and headaches, have historically been treated using a tea brewed from the fresh leaves of this plant. Carminative, diaphoretic, antiseptic, antispasmodic, vasodilator, Analgesic, and cholagogic activities are found in the leaves and blooming plant. *longifolia* L: The shoots have significant antiasthmatic, antispasmodic, carminative, and stimulating properties during the flowering season. Its leaves are used to make a tea that is intended to cure fevers, headaches, digestive problems, and other mild illnesses.

In Iran, *longifolia* is utilised as a stomach pain reliever, antispasmodic, digestive, and depurative in traditional medicine. In combination with its antipyretic, carminative, antibacterial, and stimulant effects, it is used in Iraqi traditional medicine to treatment of acute pains and sprains, as well as nasal stimulants [**26]**.

Cinnamon:

Cinnamon is a natural spice from the Lauraceae family that may be seen in practically every home. It is being used as a treatment for respiratory and intestinal (digestive) problems [**27]**. Vietnamese cinnamon (*C. loureiroi*; VC), Chinese cinnamon (*C. cassia*; CC), Ceylon cinnamon (*C. loureiroi*; VC) as well as Indonesian cinnamon (*C. burmanii*; IC) are four of the approximately 250 types of the genus Cinnamomum (*C. zeylanicum*; SC) [**28]**. Cinnamon has gastroprotective, antibacterial, anticancer, immunomodulatory, antihypertension, antioxidant, blood purifies capabilities, antidiabetic, antiviral, neuroprotective, anti-inflammatory, among other biological qualities [**29**].

Fenugreek:

Fenugreek (*Trigonella foenum-graecum*) is a spices of vegetable, and medicinal plant (Leguminosae or fabaceae family). Antioxidant characteristics in natural goods have been related to health advantages. Therefore, these characteristic were investigated in sprouted fenugreek (seeds), which are thought to be more helpful than dry seeds [**30]**. Spices in the diet have an effect on pancreatic digesting enzymes.

Fenugreek significantly increased the activity of pancreatic lipase. Fenugreek's dietary fibre content aids in constipation relief. Fenugreek seeds can help with stomach ulcers. The crude extract or a gel fraction extracted from fenugreek seeds was found to have considerable ulcer-protecting properties. The anti-secretory activity of the seeds, as well as their effects on mucosal glycoproteins, are responsible for their cytoprotective properties. The mechanism is that it increases the gastrointestinal mucosa's antioxidant capacity, which reduces mucosal damage. The most significant health benefits of fenugreek are digestive enhancements [**31**].

Thyme:

Thyme (*Thymus vulgaris*) is a pungent mint family (Lamiaceae) plant whose dried leaves and blooming tops are noted for their perfume and flavour. Thyme is a plant that originated in Eurasia and is now grown all over the world [**32**]. Cardio-protective and digestive stimulant action, anti-atherogenic potential, antidiabetic effects, anti-inflammatory, and cancer-preventive potential qualities are just a few of the health advantages claimed for dried herbs. Natural or processed foods containing recognised biologically active ingredients have been scientifically demonstrated and confirmed to provide a health benefit in the prevention, treatment, or management of illness at specific, effective, and non-toxic levels. As a result, thyme may be classified as a functional food because of the additional advantages it provides [**33**].

Nutmegh:

Nutmeg is a spice derived from the seed of a tropical evergreen tree (family Myristicaceae) called *Myristica fragrans*. The tree is endemic to Indonesia's Moluccas, or Spice Islands, and is mostly grown there in the West Indies [**34**]. In addition to being used as an aphrodisiac and an abortifacient, nutmeg and nutmeg oil have been utilised for disorders involving the neurological and digestive systems, including psychosis, stomach pains, nausea, vomiting, flatulence, and anxiety. In both Western and Chinese herbal medicine, nutmeg is often used as a muscle relaxant to expel gas from the digestive system, help relax the body, treat digestion difficulties, and reduce stomach discomfort. In Vietnam, powdered seeds with cooked rice are used to cure diarrhoea, anorexia, colic, and malarial debility [**35**]. In addition to being used as an aphrodisiac and an abortifacient, nutmeg and nutmeg oil have been utilised for disorders involving the neurological and digestive systems, including psychosis, stomach pains, nausea, vomiting, flatulence, and anxiety. In both Western and

Chinese herbal medicine, nutmeg is often used as a muscle relaxant to expel gas from the digestive system, help relax the body, treat digestion difficulties, and reduce stomach discomfort. In Vietnam, powdered seeds with cooked rice are used to cure diarrhoea, anorexia, colic, and malarial debility [**36]**.

Curcumin:

Curcumin is a bioactive compound phytochemical that belongs to the curcuminoids (family Zingiberaceae) of biologically active phenols obtained from Curcuma longa plants' rhizome (turmeric). Auto immune activity was lowered when curcumin was added to the diet. According to several clinical investigations, curcumin appears to play a role in inflammatory and functional GI illnesses. Curcumin reduced the severity of stomach discomfort and enhance the overall quality of life. In IBS patients, a combination of curcumin and fennel volatile oils (with anethole as the active component) improved symptoms and quality of life [**37]**. Curcumin in the diet reduced cholesterol levels and helped fat digestion. Furthermore, curcumin reduced total cholesterol and fat in a substantial way. Curcumin's digestion-enhancing capability might be attributable to digestive enzymes and bile secretion, curcumin's stimulatory activity for bile formation, or it could be linked to high levels of T4 that increase fat digestion. Curcumin may indeed help people with this condition enhance their quality of life [**38]**.

Artichoke:

The perpetual artichoke (*Cynara scolymus* L.) belongs to the Asteraceae family. Due to the risk of freezing throughout the winter, it is exclusively grown in Poland by amateurs [**39]**. Artichoke is a medicinal herb used for stomach problems because of its anti-dyspeptic effects, which are aided by its choleretic characteristics. Flavonoids and caffeinelike acids are phenolic metabolites found in artichoke extract. This data supports the artichoke's usage in digestion problems. Flavonoids and caffeine derivatives, which are phenolic metabolites, were developed for the treatment of digestive GI diseases, such as lack of appetite, sickness, and stomach discomfort. The symptoms of diarrhoea and discomfort were relieved after taking artichoke extract twice daily for six weeks [**40]**. Artichoke leaf extract (ALE) was found to help with IBS symptoms. In participants with indigestion and at least 3 or 5 commonly seen IBS symptoms, two capsules of ALE three times daily with meals alleviated stomach discomfort, cramps, bloating, gas, and bowel problems **[41]**. Up to

50percent of patients self-medicate using herbal and nutritional supplements or other alternative and complementary medicine techniques to elongate their quality of life and alleviate IBS symptoms, which are typically limited by major adverse effects **[42]**.

CONCLUSION

Irritable bowel syndrome (IBS) is a functional gastrointestinal (GI) disorder and includes symptoms like stomach pain or discomfort, bloating, bowel problems, constipation-predominant IBS, diarrhea-predominant IBS, IBS with major abnormal bowel habits, and celiac disease. Many patients using allopathy treatments for IBS have various side effects, so we cannot use them for long periods of time. Some ayurvedic herbs are used for long periods of time as they are already routinely used in food preparation as well as for better effects. various digestive stimulant active constituents like capcaicine obtained from chilli pepper, thymoquinon-black cumin, and thymol-ajwain, etc. These active constituents are variously used for irritable bowel syndrome. IBS patients have more digestive or bowel problems and their digestive stimulant herbs like chilli pepper, ginger, black cumin, ajwain, fennel, coriander, menthe, cinnamon, fenugreek, thyme, nutmeg, and curcumin are among the plants (parts of plants) used to treat the disease.

REFERENCES

[1] Rahimi R, Abdollahi M. Herbal medicines for the management of irritable bowel syndrome: a comprehensive review. World journal of gastroenterology: WJG. 2012 Feb 21;18(7):589-590.

[2] Irritable bowel syndrome Cleveland clinic https://my.cleveland clinic.org.

[3] Uranga JA, Martínez V, Abalo R. Mast cell regulation and irritable bowel syndrome: Effects of food components with potential nutraceutical use. Molecules. 2020 Jan;25(18):4314.pg.no.1-2.

[4] Ford AC, Sperber AD, Corsetti M, Camilleri M. Functional Gastrointestinal Disorders 2 Irritable bowel syndrome. Lancet. 2020 Nov 21;396(10263):1.

[5] Portincasa P, Bonfrate L, de Bari O, Lembo A, Ballou S. Irritable bowel syndrome and diet. Gastro-enterology report. 2017 Feb 1;5(1):11-12.

[6] Hutchings HA, Wareham K, Baxter JN, Atherton P, Kingham JG,

Duane P, Thomas L, Thomas M, Ch'ng CL, Williams JG. A randomised, cross-over, placebo-controlled study of Aloe vera in patients with irritable bowel syndrome: effects on patient quality of life. International Scholarly Research Notices. 2011;2.

[7] Shi J, Tong Y, Shen JG, Li HX. Effectiveness and safety of herbal medicines in the treatment of irritable bowel syndrome: a systematic review. World journal of gastroenterology: WJG. 2008 Jan 21;14(3):454.

[8] Saleh BK, Omer A, Teweldemedhin B. Medicinal uses and health benefits of chili pepper (Capsicum spp.): a review. MOJ Food Process Technol. 2018;6(4):325-8.

[9] Salehi B, Hernández-Álvarez AJ, del Mar Contreras M, Martorell M, Ramírez-Alarcón K, Melgar-Lalanne G, Matthews KR, Sharifi-Rad M, Setzer WN, Nadeem M, Yousaf Z. Potential phytopharmacy and food applications of Capsicum spp.: A comprehensive review. Natural Product Communications. 2018 Nov;13(11):1548.

[10] Srinivasan K. Biological activities of red pepper (Capsicum annuum) and its pungent principle capsaicin: a review. Critical reviews in food science and nutrition. 2016 Jul 3;56(9):21.

[11] Haniadka R, Saldanha E, Sunita V, Palatty PL, Fayad R, Baliga MS. A review of the gastroprotective effects of ginger (*Zingiber officinale* Roscoe). Food & function. 2013;4(6):845.

[12] Rahimi Yadkoori N, Zanguee N, Mousavi SM, Zakeri M. Effects of ginger (*Zingiber officinale*) extract on digestive enzymes and liver activity of Mesopotamichthys sharpeyi fingerlings.2015 Mar 10;6(19):1-0.

[13] Srinivasan K. Cumin (*Cuminum cyminum*) and black cumin (Nigella sativa) seeds: traditional uses, chemical constituents, and nutraceutical effects. Food quality and safety. 2018 Mar;2(1):1-2.

[14] Mnif S, Aifa S. Cumin (*Cuminum cyminum* L.) from traditional uses to potential biomedical applications. Chemistry & biodiversity. 2015 May;12(5):740.

[15] Ramadan MF. Nutritional value, functional properties and nutraceutical applications of black cumin (*Nigella sativa* L.): an overview. International journal of food science & technology. 2007 Oct;42(10):1214.

[16] Anilakumar KR, Saritha V, Khanum F, Bawa AS. Ameliorative effect of ajwain extract on hexachlorocyclohexane-induced lipid peroxidation in rat liver. Food and Chemical Toxicology. 2009 Feb 1;47(2):279.

[17] Bhadra P. An Overview of Ajwain (Trachyspermum ammi).pg.no.18471.

[18] Meena S, Lal G, Meena R. Multidimensional therapeutic uses of ajwain (*Trachyspermum ammi* L.). International J. Seed Spices. 2018 Jul;8(2):2.

[19] Khan S, Shameem I, Sahibole S, Siddiqui A. Trachyspermum Ammi: Ancient Unani Medicine For Modern Cure, A Review of Potential Therapeutic Applications. World Journal of Pharmaceutical Research. 2016 Oct 1;5(12):172.

[20] Rathore SS, Saxena SN, Singh B. Potential health benefits of major seed spices. Int J Seed Spices. 2013 Jul;3(2):4.

[21] Malhotra SK. Fennel and fennel seed. InHandbook of herbs and spices 2012 Jan 1 (pp. 289). Woodhead Publishing.

[22] Satyal P, Setzer WN. Chemical compositions of commercial essential oils from *Coriandrum sativum* fruits and aerial parts. Natural Product Communications. 2020 Jul;15(7):1.

[23] Nath P. Coriander A potential medicinal herb.pg.no30.

[24] McKay DL, Blumberg JB. A review of the bioactivity and potential health benefits of peppermint tea (*Mentha piperita* L.). Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2006 Aug;20(8):619

[25] Eftekhari A, Khusro A, Ahmadian E, Dizaj SM, Hasanzadeh A, Cucchiarini M. Phytochemical and nutra-pharmaceutical attributes of

Mentha spp.: A comprehensive review. Arabian Journal of Chemistry. 2021 May 1; 14(5):2.

[26] Mamadalieva NZ, Hussein H, Xiao J. Recent advances in genus Menthe: Photochemistry, anti-microbial effects, and food applications. Food Frontiers. 2020 Dec;1(4):435-58.

[27] Kawatra P, Rajagopalan R. Cinnamon: Mystic powers of a minute ingredient. Pharmacognosy research. 2015 Jun;7(Suppl 1):1.

[28] Hayward NJ, McDougall GJ, Farag S, Allwood JW, Austin C, Campbell F, Horgan G, Ranawana V. Cinnamon shows antidiabetic properties that are species-specific: effects on enzyme activity inhibition and starch digestion. Plant Foods for Human Nutrition. 2019 Dec;74(4):544.

[29] Saeed M, Kamboh AA, Syed SF, Babazadeh D, Suheryani I, Shah QA, Umar M, Kakar I, Naveed M, Abd El-Hack ME, Alagawany M. Phytochemistry and beneficial impacts of cinnamon (*Cinnamomum zeylanicum*) as a dietary supplement in poultry diets. World's Poultry Science Journal. 2018 Jun;74(2):10.

[30] Dixit P, Ghaskadbi S, Mohan H, Devasagayam TP. Antioxidant properties of germinated fenugreek seeds. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2005 Nov;19(11):977.

[31] Aher RR, Belge SA, Kadam SR, Kharade SS, Misal AV, Yeole P. Therapeutic importance of fenugreek (*Trigonellafoenum-graecum* L.). A review. J Plant Sci Res. 2016;3(1):3.

[32] Stahl-Biskup E, Venskutonis RP. Thyme. InHandbook of herbs and spices 2012 Jan 1 (pp. 499). Woodhead Publishing.

[33] Nieto G. A review on applications and uses of Thymus in the food industry. Plants. 2020 Aug;9(8):10.

[34] Britannica, The Editors of Encyclopaedia."nutmeg". *Encyclop edia Britannica*, 7 May. 2021.

[35] Periasamy G, Karim A, Gibrelibanos M, Gebremedhin G. Nutmeg (*Myristica fragrans* Houtt.) oils. In Essential oils in

food preservation, flavor and safety 2016 Jan 1 (pp. 608). Academic Press.

[36] Agbogidi OM, Azagbaekwe OP. Health and nutritional benefits of nutmeg (*Mystica fragrans* houtt.). Scientia Agriculturae. 2013;1(2):42-43.

[37] Uranga JA, Martínez V, Abalo R. Mast cell regulation and irritable bowel syndrome: Effects of food components with potential nutraceutical use. Molecules. 2020 Jan;25(18):4314.16.

[38] Rajput N, Muhammah N, Yan R, Zhong X, Wang T. Effect of dietary supplementation of curcumin on growth performance, intestinal morphology and nutrients utilization of broiler chicks. The Journal of Poultry Science. 2012:49-50.

[39] Sałata A, Gruszecki R, Dyduch J. The effect of gibberellic acid GA3 on morphological features of artichoke (*Cynara scolumus* L.). Modern Phytomorphol. 2013;4:87-90.

[40] Roudsari NM, Lashgari NA, Momtaz S, Farzaei MH, Marques AM, Abdolghaffari AH. Natural polyphenols for the prevention of irritable bowel syndrome: molecular mechanisms and targets; a comprehensive review. DARU Journal of Pharmaceutical Sciences. 2019 Dec; 27(2):13.

[41] Yoon SL, Grundmann O, Koepp L, Farrell L. Management of irritable bowel syndrome (IBS) in adults: conventional and complementary/ alternative approaches. Alternative Medicine Review. 2011 Jun 1;16(2):139.

[42] Grundmann O, Yoon SL. Complementary and alternative medicines in irritable bowel syndrome: an integrative view. World Journal of Gastroenterology: WJG. 2014 Jan 14;20(2):349.