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Role of Ayurvedic Herbs in the Management of Celiac Disease

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Celiac disease or gluten-sensitive enteropathy is an autoimmune hypersensitivity disorder affecting the small intestine. It occurs due to an inappropriate immune reaction to gluten, which results in inflammation and damage to the small intestine**.** One of the most prevalent illnesses, celiac disease, is brought on by both environmental (gluten) and genetic causes of human leukocyte antigen (HLA) and non-HLA genes. The prevalence of celiac disease has been estimated to approximate 0.5%-1% in different parts of the world. Due to improved physician awareness and expertise, as well as the widespread use of extremely sensitive and precise diagnostic tests for celiac disease, the prevalence of celiac disease has considerably grown in the past 30 years. While older children have either limited or unusual symptoms, only a small percentage of celiac patients have the classic signs of the condition like chronic or intermittent diarrhea, failure to thrive, weight loss, delayed puberty, short stature, nausea, vomiting, chronic abdominal pain, abdominal distension, chronic constipation. Early detection of celiac disease is crucial to preventing long-term

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consequences. According to *Ayurveda*, some symptoms of celiac disease found in *Grahani Dosha*. *Grahani* is described as an *Agni Adhisthana* by most of *Acharya. Mandagini* is the root cause of *Ama Dosha,* and it is a crucial factor for the manifestation of most diseases. The treatment approach of celiac disease in *Ayurveda* medicinal science involves the intake of various preparations of some specific medicinal plants like *Kutaja (Holarrhena antidysenterica) Pippali,* **(***Piper longum Linn*.), *Chitraka,* ***(***Plumbago zeylanica*) Guduchi, (Tinospora cordifolia*) Ashwagandha**,** (Withania somnifera)**,** Haridra *(Curcuma longa* Linn.), *e*tc which have *Agni Deepana* and *Ama Pachana* properties. These illness-specific medicinal herbs help normalize digestive fire and evict "*Ama*" toxins from the body channels, which pacify the vitiated *Agni* and maintain homeostasis among vitiated *Doshas.*

Keywords: Ayurvedic herbs; ashwagandha; celiac disease; chitraka; grahani dosha; grani roga; guduchi; haridra and kutaja.

1. INTRODUCTION

Celiac disease (CD) is an immune-mediated systemic disease triggered by the intake of gluten and related Prolamins in genetically susceptible individuals, characterized by the presence of various combinations of small intestinal damages, celiac-specific antibodies, human leukocyte antigen (HLA)-DQ2 or HLA-DQ8, and gluten-dependent clinical manifestations [1]. Gluten is found in wheat, barley, rye, and oats [2]. CD-specific antibodies comprise autoantibodies against type 2 transglutaminase (TG2), endomysial antibodies (EMAs), and antibodies against deamidated gliadin peptides. Celiac disease is a common disorder with about 1% prevalence of biopsy-proven disease. In East Asia and Central Africa, it is assumed to be uncommon. Although autoantibodies turning celiac disease into a systemic disease develops in genetically susceptible individuals, environmental factors might affect the risk of developing celiac disease or the timing of its presentation. Even after gluten is added, there is no proof that breast milk increases the risk of celiac disease. The cumulative prevalence of both autoimmunity (positive serology) and celiac disease in later childhood is unaffected by the earlier intake of gluten. It is recommended to introduce gluten into a baby's diet any time between 4 and 12 months of age. Due to the association between repeated rotavirus infections and a higher risk of celiac disease, it has been hypothesized that infectious agents are responsible for the condition [3]. It is plausible that contact with gliadin when there is ongoing intestinal inflammation alters intestinal permeability, and the enhanced antigen presentation can increase the risk of developing celiac disease, at least in a subset of persons. The likelihood of getting celiac disease has been linked to the manner of delivery, socioeconomic level, season of birth, and medication usage; however, the data is conflicting. When a person with celiac disease consumes gluten, their own immune system assault and damage the intestinal villi. This ongoing assault damages the tiny intestinal villi permanently over time by altering their structure. Since intestinal villi are involved in both the absorption of nutrients from food and the defense against dangerous microorganisms, celiac disease affects both the immune system and digestion**.** The exact mechanism of how celiac disease occurs is not fully understood. However, a mix of genetic and environmental variables is likely responsible for its development. In those who are genetically susceptible to the disorder, some experts think that an infection or another environmental event brings on celiac disease. Such patients are then unable to absorb the food nutrients in good aspect, which leads to many physiological disturbances, a few of those being loss in bone density, neurological diseases, etc [4].

The small intestine's enterocytes are damaged, resulting in celiac disease symptoms. In the full-blown clinical picture, the typical features of the small intestine are chronic inflammation and villi atrophy [5]. An individual has to have HLA-dominant DQ2 or DQ8 genes.

An essential protein in the illness process is an antibody to tissue transglutaminase. The disease is caused by the immune system responding negatively to gluten. Other possible paths that lead to the illness have been suggested, however. Through its up-regulation of IL-15 production, the glycoprotein gliadin found in gluten directly damages enterocytes.

According to particular research, early childhood gastrointestinal infections may have a connection

to the eventual onset of celiac disease. This makes sense, given the organ in question, but it is also probably directly related to the theory that CD is an immune system malfunction. The diagnosis of celiac disease is frequently made using IgA antibodies against tissue transglutaminase and smooth muscle endomysium. However, about 5% of patients with CD have a deficiency of this immunoglobulin [6]. The classic presentation in children manifests as failure to thrive, abdominal distention, and steatorrhea that occurs a few weeks to a few month after gain is introduced into diet, usually between 4 to 24 month old. Nausea and vomiting are common in childhood – onset celiac disease. some patients have more suitable symptoms and sign that can include edema, anemia, dental carries related to defective dental enamel. In older children, recurrent abdominal pain, fall in growth percentile, or iron deficiency should suggest the possibility of celiac disease. Presentation of celiac disease in adult varies. Adults sometimes present in similar fashion to children with diarreha and weight loss, but they rarely have nausea and vomiting. Patients often have symptoms suggesting irritable bowel syndrome (IBS), and thus can be misdiagnosed [7]. All individuals with celiac disease are advised to adhere to a rigorous gluten-free diet. Following this adherence plan is advisable while closely supervised by experts, such as dietitians. On a gluten-free diet, symptoms often improve after a few days or weeks. Unresponsive patients require a reconsideration of the diagnosis and an evaluation of their diet compliance. Serology testing can assess compliance. Non-compliance can be unintentional in an individual still ingesting gluten without realizing it [8,9]. Other tests include looking at the impact of malabsorption (due to CD). The whole blood count, iron reserves, folate, ferritin, vitamin D, fat-soluble vitamin levels, and bone mineral density may all be tracked. It is debatable how to treat patients whose duodenal biopsies reveal nothing wrong but whose serology is positive. The diagnosis is often not definitive in many cases. Despite a tiny gut biopsy finding no abnormalities, some people have pertinent symptoms. There is also seronegative celiac disease. This term describes the reverse situation when, despite typical symptoms, there is no serological evidence of the disease, and there is significant villous atrophy of duodenal biopsy. Currently, the only recommended treatment for celiac disease is a gluten-free diet. Maintaining this may not be easy and has a significant effect on the lives of those who are impacted. Research into potential non-dietary treatments that might help gluten intolerance in individuals with celiac disease is ongoing. Immune modulators are a primary topic of interest for this field of research [10]. Other approaches, like immunizations or ingesting substances that would change the toxicity of gluten, are also being explored. None have advanced to the point where they may be suggested or authorized for this therapy. Few people with celiac disease benefit from corticosteroids.

1.1 Aims and Objectives

1. To reveal hidden facts in Ayurveda for celiac disease.
2. To collect the research on ayurvedic treatment for celiac Disease

1.2 Materials and Methods

The study's primary materials were collected from *Ayurvedic* classics like the *Charaka Samhita* and *Sushruta Samhita* and contemporary textbooks using digital media, such as the A.Y.U.S.H. Research Portal, Pubmed, Google Scholar, and other subject-related websites on the internet.

2. AYURVEDIC PERSPECTIVE OF CELIAC DISEASE

Although the exact correlate of celiac disease is not available in *Ayurvedic* classics, based on similarities of symptoms, this disease may be assumed to be equivalent to *Grahani Dosha*, explained in *Ayurveda* in detail. As per the *Ayurvedic* texts, *Grahani Dosha* comes into existence with *Agni-Dusti* (the derangement of digestive fire) [11]. Digestion is ruled by *Agni,* supported by the three *Dosha* (body humours). Hence, any derangement in Agni or imbalance of one or more Dosha can hamper digestion, ultimately leading to the disease of *Annavaha Srotas*. According to *Ayurvedic* literature, wheat is endowed with *Madhura Rasa* and *Sheet-Snigdha-Guru Guna*. It increases *Kapha Dosha* and brings about *Mandagni* (weakness of digestive fire), which ultimately leads to the formation of Ama (toxins), which is responsible for the existence of *Grahani Dosha* [12,13]. Following the medical discipline of *Ayurveda*, celiac disease is a form of ailment largely brought on by a weaker digestive fire in the digestive system, known as *Agni* or *Jathragni*. *Madagini* slows down the digestion of food, causing it to either travel upwards or downwards.

When it worsens, it can cause diarrhoea, atrophy of the villous tissue, and inflammation of the mucosa of the small intestine. During this episode of dyspepsia, the meal is not split down into "Sam" portions but rather into "Ama" parts.In addition, because of all these digestive troubles, the bone tissues are not adequately fed, which causes osteoporosis. Other *Dhatus* like *Rasa*, *Asthi Kashya*, and *Majja Kashya* are also not adequately nourished, leading to diseases associated with them. All weak Agni, i.e., Ama Dosha, result from faulty food digestion caused by *Mandagni*. The majority of ailments have this *Ama Dosha* as their underlying cause. It is crucial to understand the pathophysiology of *Grahani Roga*. *Grahani* is challenging to diagnose and tricky to cure because it is one of the eight main disorders. According to *Ayurveda*, the symptoms include *Muhu Baddha* and *Drava Mala Pravritti* (either constipation or loose feces), *Apachana* (indigestion), *Aruchi* (anorexia), and *Udara Shoola* (abdominal discomfort) [14]. Treatment of *Grahani Dosha* in *Ayurveda,* like other diseases, proceeds with adopting *Sanshodhan-Vidhi* (emesis), complementing palliative medicines [15]. The use of medicinal herbs with *Agni Deepana* and *Aam Pachana* characteristics is part of the *Ayurvedic* medical science's approach to treating celiac disease. These therapeutic plants for certain illnesses aid in restoring a regular digestive fire and expelling *Ama*" poisons from the body's channels. Thus, this line of natural treatment approaches through the intake of medicinal plants helps completely reverse the condition and enables holistic health benefits [16]. When the food ingests, it is left undigested; it is then transformed into "*Ama*" (toxins), and it either travels upwards or downwards before causing any disease. The direction and the seat where this *Ama* gets lodged becomes the disease's root origin, and the signs/symptoms are then concentrated around that specific tissue/organ. So, treating signs is never a priority in Ayurveda and only when addressing the root cause. Thus, *Ayurveda* can alleviate all the signs and address ailments. In particular, if the "*Ama*" or toxins move downward, it causes inflammation of the small intestine mucosa and constipation by unbalancing the bowel movements [17].

3. HERBS EFFECTIVE IN CELIAC DISEASE

Ayurvedic herbs such as *Kutaja*, *Pippali*, *Chitraka*, *Guduchi*, *Ashwagandha*, and *Haridra* effectively treat celiac disease. A detailed description of these herbs is given below-

3.1 *Kutaj:- Holarrhena antidysenterica (syn. H. pubescens*)

Rasa of Kutaja is Tikta, Kashaya, Laghu, Rooksha Guna, Sheeta and Katu Vipaka & Veerya [18]. Chemical constituents' steroidal alkaloids, such as conanines, 3-aminoconanines, 20-aminoconanines, 3-aminopregnans, 3,20-diaminopregnanes and their derivatives. A new steroidal alkaloid was isolated and characterized and designated holadysenterine. Corresponded to the molecular formula $C_{23}H_{38}N_2O_3$ [19]. The stem bark of *Holarrhena antidysenterica* also contains conessine($C_{24}H_{40}N_2$), isoconessine ($C_{24}H_{40}N2$), conessimine/ isoconessimine ($C_{23}H_{38}N_2$), conarrhimine ($C_{21}H_{34}N_2$) [20]. Methanolic leaf extract of *Holarrhena antidysenterica* revealed inhibition of rat paw edema induced by carrageenan. Furthermore, the Methanolic extract of *Holarrhena antidysenterica* suppressed acetic acid-induced writhing response dose-dependently and demonstrated the analgesic effect by improving tail-flick latency [21]. Ethanolic extract of H. *antidysenterica* exhibited an analgesic effect by suppressing writhing response in albino mice. In 2,4-Dinitrobenzene sulfonic acid-induced colitis in male albino Wistar rats, methanolic bark extract of H. *antidysenterica* demonstrated increased levels of glutathione and superoxide dismutase and lowered levels of nitric oxide and malondialdehyde. The lower nitric oxide level suggests the antiinflammatory impact may be due to decreased iNOS production. Treatment with H. *antidysenterica* also inhibited goblet cell rupture, inflammatory cellular infiltration, and mucosal layer inflammation [22]. Rats' dry weight of excrement increased significantly when exposed to ethanolic seed extracts of *H. anti-dysenterica*. In contrast, their defecation decreased in castor oil, and *E. coli*-induced diarrhea decreased [23]. Rats with castor oil-induced diarrhea had significantly less watery diarrhea and motility in the small intestine when given the H. *antidysenterica*-marketed product *Kutaja Parpati Vita*. Additionally, it demonstrated a note-worthy 67.55% defense against diarrhea caused by castor oil [24]. A well-known plant called *Kutaja* controls the elevation of the *Pitta* and *Kapha Doshas*. It is a fantastic plant used to cure irritable bowel syndrome, diarrhea, and other conditions. Bark, seeds, flowers, and fruits are all excellent sources of Medicine.

3.2 Pippali (*Piper longum Linn*.)

Pippali belongs to the *piperaceae* family. *Ayurvedic* properties of *Pippali* are *Katu*, *Tikta*, *Madhura Rasa, Laghu*, *Snigdha Guna,* and *Madhur Vipaka* [25]. It is one of the prime *Rasayana* (rejuvenator) drugs in *Ayurveda* and is widely used to treat various diseases, especially for treating intestinal disorders [26]. In *Ayurveda*, this plant's root is called *Pippali Mula*. At the same time, its fruits (spike) are mostly utilized for *Rasayana*. Chemical Constituents Two alkaloids piperlongumine & piperlonguminine, n-hexadecane,n- heptadecane, n-octadecane,n-nonadecane n-eicosane, n-heneicosane, n-thujene, terpinolene, zingiberene, p-cymene, p-methoxy acetophenone, traces of dihydrocarveol, phenyl ethyl alcohol & two sesquiterpenes; piperine, piplartin, triacontane, dihydrostigmasterol, an unidentified steroid, reducing sugar, glycosides, sesamin & methyl-3.4.5- tri methoxycinnamate (root); major alkaloid piperine & sesamin (stem& fruit); sesquiterpene hydrocarbon, caryophyllene, a sesquiterpene alcohol, carbonyl compound (essential oil), N-isobutyldeca- trans- 2-trans- 4-dienamide, piperine, piplartine & a lignan d-sesamin, two piperidine alkaloids pipernonaline& piperundecalidine (fruit), sylvatinsesamin & diaeudesmin (seed) [27]. A decoction of P. *Longum* fruits has been shown to have a significant antiinflammatory effect in rats with edema caused by carrageenan [28]. Rat paw edema caused by carrageenan leukotrienes' Cox-1 inhibitory action and prostaglandin are inhibited by P. longum extract and piperine, which has antiinflammatory properties [29-30].

According to Stohr JR et al. (2001), piperine and extracts from piper have an inhibitory effect on leukotrienes' COX-1 inhibitory action and prostaglandin, which results in antiinflammatory activity [31]. The antioxidant activity of *Amrita Bindu*, a mixture of herbs (*Plumbago zeylanica* and *Cyperus rotundus*), spices (*Piper nigrum*, *Piper longum*, and *Zingiber officinale*), and salts were examined. Using the following order, the investigation showed the components' potential as antioxidants: *Zingiber officinale*, *Plumbago zeylanca*, *Piper nigrum*, *Piper longum*, *Cyperus rotundus*, and Pluto [32]. P. *longum* root is used for opioid-type analgesia using the rat tail-flick method, while ibuprofen and pentazocine are used as pharmacological controls for NSAID-type analgesia using the acetic-acid writhing method. Mice and rats were orally administered an aqueous P. longum root powder suspension. The study found that P. *longum* root had strong NSAID-type analgesic effects but minimal opioid action [33]. In addition to the water decoction of P. *longum* and the colloidal solution of Ferula asafoetida, Agrawal et al. [11] reported the antiulcer activity was demonstrated by water decoction of ginger, one of the constituents of *Mahakasyaya* drugs, which has been reported to protect against C.R.S.-, A.S.P.-, and PL-induced gastric ulcers in rats. In a dose- and time-dependent manner, piperine, an alkaloid of P. *longum*, slowed the stomach emptying of solids/liquids in rats and gastrointestinal transit in mice. The inhibitory effect of piperine on stomach emptying occurs independently of the release of gastric acid and pepsin [34].

3.3 Guduchi (*Tinospora cordifolia* (Wild.)

Belongs to the *Menispermace* family. Rasa is *Tikta*, *Laghu, Snigdha in Guna, Ushna* in *Veerya,* and Madhur in *Vipaka* [35]. It harmonizes the body's *Tridosha*. *Guduchi* is a good source of antioxidants. It also has antiviral, antipyretic, and wound-healing properties [36]. Many chemicals have been discovered in T. *cordifolia*, including phenolic compounds, aliphatic compounds, steroids, glycosides, alkaloids, and diterpenoid lactones. A few of the *Ayurvedic* benefits of T. *cordifolia* are *Aruchinashaka*, *Dipana*, *Agnidipana*, *Chardihara*, *Trishnahara*, and *Trishnanashaka* [37]. It has been shown that the ulcer index total acidity falls when a T. *cordifolia*-containing formulation is used, the pH of the stomach fluid of rats ligated with pylorus rises, and rats' ethanol-induced gastric mucosal damage reduces [38]. In rats, the carrageenin-induced acute and chronic inflammation was significantly reduced by the aqueous extract of *Tinospora cordifolia*; this reduction was comparable to that of N.S.A.I.D.S. The local reaction of living mammalian tissues to any kind of agent-induced harm is known as inflammation. It is the body's protective response to get rid of or stop the spread of an inflammatory substance. It is categorized as acute or chronic depending on the host's defense capability and the response length. Acute inflammation is characterized by several key elements, including the build-up of fluid and plasma, intravascular platelet activity, and polymorphonuclear neutrophils acting as inflammatory cells [39]. In the early stages of inflammation, caused by carrageenan, histamine, 5-hydroxytryptamine, and bradykinin are the first mediators that may be detected; prostaglandins are detected in the later stages of inflammation. According to a

study, *Guduchi* Ghana made using the traditional way significantly reduces the amount of edema caused by carrageenan, suggesting that it prevents fluid exudation and, consequently, acute inflammation. It could be explained by *Guduchi* Ghana's capacity to alter the function of different chemical mediators of inflammation, such as histamine and 5 H.T., during the early stages of inflammation by either attenuating the synthesis of these mediators or activating them at the receptor level [40]. Thus, it has been demonstrated that *Guduchi* Ghana cooked traditionally has a notable antiinflammatory effect [39,40]. A reduction in ulcer index and a dose-dependent anti-diarrheal effect were observed in rats used to test this activity. Additionally, there was a decrease in stomach capacity and an increase in pH in the stomach [41]. PGE2, proangiogenic factors (VEGF, EGF), and antiinflammatory cytokines (IL-4, IL-10) are increased by the epoxy clerodane diterpene that is isolated from this plant [42]. Its extract had protective effects in an 8-hour model of ulceration in mice generated by restraint stress, and the outcomes were similar to those of diazepam [43].

3.4 Ashwagandha (Withania somnifera)

Ashwagandha (*W. somnifera*) belongs to the genus *Withania* and the family *Solanaceae.* Ras is Katu, Tikta, Kashaya, Guna, Snigdha, Laghu Veerya and Vipaka, and Ushna and Katu [44]. It balances Tridoshas, especially Kapha and Vata*. Ashwagandha* is an essential source of many medicinally and pharmacologically necessary chemicals such as Alkaloids (isopelletierine, anaferine, cuseohygrine, anahygrine, etc.), steroidal lactones (withanolides, withaferins), and saponins are major chemical constituents [45]. Withaferin A and 3 -b hydroxy 2. Dihydro with anolide F isolated from *Ashwagandha* shows promising antitumoral, immunomodulating, antibacterial, and antiinflammatory properties. The bark powder is an appetizer, carminative, and antihelminthic and hence used in abdominal pain, constipation, and worms. It affects the heart, purifies the blood, and reduces *Ashwagandha. It* has been widely studied for its various pharmacological activities, such as antioxidant, anxiolytic, adaptogen, memory enhancing, antiinflammatory, and antitumor properties. Many diseases linked to inflammation in the body, including diabetes, cancer, neurological diseases, autoimmune diseases, respiratory diseases, and cardiovascular diseases, are being researched concerning *Ashwagandha* or *Withania somnifera*. Preclinical research has shown that this plant inhibits inflammatory markers such as cytokines (like TNF-a and IL-6), nitric oxide, and reactive oxygen species, reducing inflammation and regulating mitochondrial activity and apoptosis. Meanwhile, *Ashwagandha* root powder's possible inhibitory action in lupus-ridden mice was shown in cases of proteinuria and nephritis [46].

Evidence from a study by Kanjilal et al. suggested that people with arthritis may benefit from applying *Ashwagandha* extract for eight to twelve weeks [47]. A study on the impact of *Withania somnifera* root powder on the stimulation of immunological activity in immunodeficient mice validated the immunomodulatory effect. When *Withania somnifera* is administered, it has been observed to raise the overall count of white blood cells and bone marrow cells, as well as the titer of circulating antibodies and antibody-producing cells. It also promotes the phagocytosis of macrophages and the synthesis of immune cells [48].

Ashwagandha has several additional benefits, including hypolipidemia, immunomodulation, and antibacterial cardiovascular protection. Moreover, somnifera has demonstrated its ability to regulate apoptosis, lessen reactive oxygen species, adjust mitochondrial activity, and lower inflammation [49]. Moreover, it can improve endothelial function. Traditional medicine uses withaferin-A, an essential phytoconstituent of W. *somnifera* that belongs to the withanolides class, to treat a wide range of illnesses [50].

Although *Ashwagandha* helps promote better digestive health, it is critical to comprehend the connection between gut health and general well-being. The digestive system handles food digestion, nutrient absorption, waste removal, and the preservation of a balanced gut microbiota. An unbalanced digestive system can result in bloating, constipation, diarrhea, and inflammation, among other symptoms and health problems. *Ashwagandha* may help regulate the production of stomach acid, which helps lessen symptoms of acid reflux and ulcers, as well as enhance digestion and nutritional absorption by encouraging the growth of beneficial gut flora [51].

3.5 Chitrak (*Plumbago zeylanica*)

Plumbago zeylanica Linn. (*Chitraka*) is one of the most important plants. A member of the

Plumbaginaceae family is *Plumbago zeylanica* Linn. *Rasa-Katu, Guna-Laghu, Tikshna, Ruksha, Virya-Ushna,* and *Vipaka-Katu* are some of the characteristics of *Chitraka* [52] chemical components of *Chitraka* include flavonoids, alkaloids, glycosides, steroids, triterpenoids, saponins, tannins, coumarins, phenolic compounds, naphthoquinones, carbohydrates, fixed oil and fats and proteins. Among them, the most critical chemical constituent is plumbagin, which is chiefly present in the roots of Chitrak and the plant and has incredible curative qualities. Sheeja et al. used in vivo experimental models to study the antiinflammatory properties of acetone and petroleum ether extracts of *Plumbago zeylanica* L. [53] leaves at two doses (200 and 400 mg/kg, p.o.). The acetone extract considerably reduced the inflammation caused by carrageenan in rats compared to the control group. According to the study, the extract's antiinflammatory properties may be due to a decrease in prostaglandin synthesis and release as opposed to inflammatory chemicals that have already been produced [54]. Plumbago *zeylanica* L. dichloromethane extract was tested at 250 mg/kg and 500 mg/kg by Subra Maniyan et al. in response to carrageenan-induced paw edema. According to a study, edema's inhibitory impact was on par with the common medication diclofenac. According to the study, its ability to scavenge free radicals and defend against apoptosis may be responsible for the inhibitory effect [55]. The effects of aqueous extract of *Plumbago zeylanica* L. root on acute stomach ulceration in albino rats caused by aspirin and indomethacin. Together with negative and positive control groups, they calculated and compared the extract's ulcer score, index, and percentage protection. At 25, 50, and 100 ml/kg, the extract showed significant dose-dependent suppression of aspirin-induced stomach mucosal damage; at 50 and 100 mg/kg, respectively, the extract demonstrated inhibition of indomethacin-induced ulcer [56].

In the conventional medical system, *Plumbago zeylanica* L. has been highly recommended for its ability to heal wounds. Significant wound healing activity of *Plumbago zeylanica* L. roots extract in Wistar rats was observed by Kodati et al. On the wound's surface, 10% (w/w) extract ointment was applied to assess the wound healing activity. It was discovered that starting on the sixth day, the rats given extract showed a notable improvement in their ability to close wounds. With the extract, there was a more significant percentage of wound contraction and a shorter wound closure time. Furthermore, the groups treated with the extract showed complete wound healing in 16 days, while the control group showed epithelization in more than 20 days [57]. *Chitrak's* carminative, antiinflammatory, expectorant, diuretic, androgenic, analgesic, anti-convulsant, adaptogenic, anti-pyretic, and muscle-relaxant properties make it a popular choice for the treatment and management of digestive disorders. *Chitrak* is a traditional remedy for gastrointestinal disorders that include heartburn, indigestion, diarrhea, flatulence, peptic ulcers, esophagitis, and stomach discomfort. It is also used to support gut health. As a carminative herb, it facilitates the breakdown of food particles in the stomach and intestine, stimulates the flow of digestive juices, and improves intestinal absorption of essential nutrients. Additionally, aiding in the expulsion of stomach gas reduces bloating, abdominal distension, and gastric cramps. Herbal laxatives work by allowing excrement to pass freely from the anus [58].

3.6 Haridra (Turmeric):-(*Curcuma longa* Linn.)

Haridra (*Curcuma longa* Linn**)** belongs to the *Zingiberaceae* family. *Rasa* is *Katu*,*Tikta*, *Guna* is *Laghu, Ruksha Vipaka* is *Katu*,*Veerya Ushna* [59]. Chemical components of turmeric are named curcuminoids, which include mainly curcumin (diferuloylmethane), demeth - oxycurcumin, and bisdemethoxycurcumin. Curcumin (diferuloylmethane) is a polyphenol derived from the *Curcuma longa* plant, commonly known as turmeric. The active constituents of turmeric are the flavonoid curcumin diferuloylmethane) and various volatile oils, including tumerone, atlantone, and zingiberone. Curcumin works by interacting with the gut microbiota, a population of bacteria, fungi, and viruses that live in the intestines of humans and aid with digestion and immunity. During the developmental stage of the fetus, the microbiota begins to colonize. When fully grown, these organisms not only fight infections but also help to regulate metabolism, produce vitamins B and K, and support the growth of the immune system [60]. Turmeric inhibits nuclear factors (N.F.)-B, which in turn decreases the synthesis of adhesins and inflammatory mediators, hence lessening intestinal damage in cases of induced gastropathy. Following therapy, turmeric reduces mucus damage to the stomach and prevents leukocyte adhesions, ICAM1 sticky proteins, and TNF production. *Curcuma longa* extract pills

considerably reduced the incidence of I.B.S. and the ratings of stomach discomfort throughout eight treatments. Substantial improvements were observed in the I.B.S. life quality (Q.O.L.) measurements. Male mice who have APAP-induced cirrhosis are protected from it by curcumin, which improves liver histology by lowering oxidative stress, decreasing inflammation in the liver, and raising G.S.H. levels [61]. In rat mesenteric myeloid cells, curcumin-suppressed degranulation and the adrenaline substance 48/80-induced discharge. Curcumin decreased the chemical that might cause passive cutaneous anaphylactoid response mediated by anti-DNP immunoglobulin E (IgE) in vivo and systemic anaphylaxis in vitro. Curcumin reduces allergic reactions mediated by mast cells, both specific and general. Indian materia medica provides a thorough explanation and documentation of the medical benefits of turmeric, also known as *Haridra*. It helps with I.B.S. and is regarded as the greatest anti-helminthic for G.I.T. disorders. Haridra is the best herb for respiratory issues like rhinitis, bronchitis, sore throats, and coughs. Numerous studies have determined that the most potent antiinflammatory medication is curcumin.

Curcuma Longa rhizome ethanolic extract has a significant hepatoprotective effect when taken orally. Among antioxidants, it ought to be among the best [62]. It is believed that Curcuma oil mitigates nitrosative and oxidative stress, shielding against the deleterious consequences of ischemia. The successive induction of apoptosis was significantly inhibited by Curcuma oil. In light of this, research demonstrates the remarkable neuroprotective properties of curcuma oil. Studies on individuals, animals, and cell cultures have all shown that turmeric possesses chemo-preventive qualities. Curcumin is thought to have anti-cancer potential because of its effects on mutations, oncogenic transcription, cell cycle regulation, apoptosis, carcinogenesis, and metastasis. Numerous malignancies have also been found to possess anti-proliferative properties. Curcumin stops the passive cutaneous anaphylactoid reaction caused by anti-DNP immunoglobulin E(IgE) in vivo and global anaphylaxis in vitro. One potent inhibitor of drug resistance is curcumin. It possesses a remarkable ability to prevent the upregulation of P-glycoprotein's mRNA. Curcumin has a well-established synergistic anti-cancer effect. In West Bengal, Uttar Pradesh, and Bihar, Curcuma longa's rhizome is traditionally used to treat coughs, colds, and loose stools. The benefits of *Haridra* as a therapeutic and prophylactic treatment are well-known worldwide [63].

4. DISCUSSION

In celiac disease, the small intestine's inner lining is damaged by an immune reaction, which stops it from absorbing nutrition. This disorder is known as malabsorption. Growth and development are delayed in children with celiac disease. When persons with celiac disease ingest gluten-rich foods, their immune systems respond to it. (The protein known as gluten is found in wheat, rye, oats, and barley.) Symptoms such as severe stomach pain and discomfort, digestive discomfort, and diarrhoea result in inflammation in the small intestine. The response damages the villi of the small intestine. Villi are responsible for absorbing vitamins and minerals. The body might absorb insufficient nutrients if these villi are destroyed. According to *Ayurveda*, this illness denotes a *Dosha* imbalance in the body that weakens the immune system and digestion. Poor food and lifestyle choices weaken immunity by vitiating *Pitta* and *Vata* in the gut. The digestive system is too sensitive, which results in an allergic response to some gluten-containing meals. It causes food malabsorption, resulting in loose stools, weight loss, etc. Digestive problems in children with celiac disease are more common than in adults and might include nausea and vomiting, persistent diarrhoea, abdominal discomfort, constipation, gas, pale, offensive feces, etc. According to *Ayurveda*, some symptoms of celiac disease found in *Grahani Dosha*. *Grahani* is described as an *Agni Adhisthana* by most of *Acharya*. *Mandagini* is a root cause of *Ama Dosha,* and it is a crucial factor for most diseases' manifestation. Among them is the prime gastrointestinal tract disease, which is often seen. The management approach of celiac disease in *Ayurveda* proceeds with the adoption of *Sanshodhan-Vidhi* (emesis/Purgation), and the use of palliative medicines complements it. These therapeutic plants for certain illnesses aid in restoring a regular digestive fire and expelling "*Ama*" poisons from the body's channels. Thus, this line of *Ayurveda* treatment approaches through the intake of medicinal plants helps completely reverse the condition and enables holistic health benefits. In the management of celiac disease, Some *Ayurvedic* herbs like *Kutaja*, *Pippali*, *Chitaka*, *Guduchi*, Ashwagandha, Haridra, etc. are found effective in managing this disease, which has *Agni Deepana* and *Aam Pachana* and

antiinflammatory properties. These illness-specific medicinal herbs help normalize digestive fire and evict "*Ama*" toxins from the body channels. *Kutaj* has antiinflammatory and anti-dysenteric properties and inhibits goblet cell rupture, cellular infiltration, and mucosal layer inflammation [64]. *Pippali* has antiinflammatory, antioxidant, and anti-ulcer properties, and the inhibitory effect of piperine on stomach emptying occurs independently of the release of gastric acid and pepsin [65]. *Chitraka* has carminative, antiinflammatory, diuretic, androgenic, analgesic, adaptogenic, anti-pyretic, and muscle-relaxant properties making it a popular choice for the treatment and management of digestive disorders [66]. As a carminative herb, it facilitates the breakdown of food particles in the stomach and intestine, stimulates the flow of digestive juices, and so improves the intestinal absorption of essential nutrients. Additionally, aiding in the expulsion of stomach gas reduces bloating, abdominal distension, and gastric cramps. Herbal laxatives work by allowing excrement to pass freely from the anus. *Guduchi* has antiinflammatory, antiviral, antipyretic, and wound-healing properties [67]. Ashwagandha has shown promising immunomodulating as well as antibacterial and antiinflammatory properties**,** antioxidant, anxiolytic, and adaptogen properties [68]. Haridra has antiinflammatory, anti-diarrhoeal, hepatoprotective, and antioxidant properties [69]. These herbal drugs are used for the management of celiac disease.

5. CONCLUSION

Celiac disease is a lifelong multi-systemic disease triggered by intake of gluten in genetically susceptible individuals. It is determined from the above description that *Annavaha Srotas-Dusti* vitiation causes celiac disease. As a result, such herbs and herbal-mineral formulations are needed, which may reduce celiac disease pathogenesis and create homeostasis among vitiated *Doshas*. Several experimental and clinical research established that *Kutaja*, *Pippali*, *Chitaka*, *Guduchi*, *Ashwagandha,* and *Haridra* are useful herbs in treating celiac disease, which are safe, cheaper, and risk-free.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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