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REVIEW ARTICLE

Traditional Kerala Ayurvedic Formulations as a Guideline for the Management of Inflammatory Bowel Disease (IBD) – A Review

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Abstract

Inflammatory Bowel Disease (IBD) refers to conditions characterized by the presence of idiopathic intestinal inflammation. The main challenge in the management of IBD is the adverse effects associated with the currently available drugs. Also, not all patients respond completely to the conventional treatments of IBD and its efficacy wanes over time. Thus, the use of complementary and alternative medicine is increasing, as a safer alternative. Certain traditional Ayurveda literature of Kerala describe a condition termed *'jatara vrana'* (ulcer of the gastrointestinal tract), which, along with its associated clinical features, resembles IBD. Due to the similarity in pathology and presenting features, the line of treatment adopted in the management of *jatara vrana* may be extended to that of IBD. A close observation of the formulations described in the management of *jataravrana* described in Chikitsamanjari (a regional Ayurvedic literature of Kerala) reveals that in each formulation individual drugs with varying mechanisms of action, including anti-ulcerative (*vranaropana*), anti-diarrheal (*atisaraghna*), anti-inflammatory (*sophahara*), anti-pyretic (*jwarahara*) or analgesic (*vedanahara*) activities, have been logically selected and combined. The active components of some of these drugs have been proven to have various effects in IBD pathology. Though these treatment principles have been used traditionally and Ayurvedic management is promising in many experimental models, it is essential to supplement it with well-designed clinical trials to define the exact role of each of these formulations in the prevention or management of IBD.

Keywords: Chikitsamanjari, Inflammatory Bowel Disease (IBD), *Jataravrana,* Kerala Ayurveda Literature

1. Introduction

The term 'Inflammatory Bowel Disease' (IBD) refers to conditions characterized by the presence of idiopathic intestinal inflammation[1]. Prevalence of IBD was known to be high in the western countries, but recently there has been a rising incidence and prevalence of disease in India, topping the Southeast Asian (SEA) countries[2]. Urbanization, changes in dietary patterns, an improvement in hygiene and environmental conditions and genetic predisposition are the possible factors leading to a rise in the IBD burden[3]. Ulcerative Colitis (UC) and Crohn's Disease (CD) are the two types of IBD that have protracted relapsing and remitting course, usually extending over years. Both, ulcerative colitis and Crohn's disease, are characterized by mucosal inflammation/ ulcers, diarrhoea, rectal bleeding, abdominal pain, fatigue and weight loss[4]. The ulcers are continuous and involve the superficial layers (mucosa and submucosa) of the bowel wall in ulcerative colitis and is usually limited to the lower gastrointestinal tract (GIT), often involving the rectum and distal colon (procto-colitis). Crohn's disease, on the other hand, has intermittent lesions, called skip lesions, and is transmural (involving all layers of the

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bowel wall). It can affect any portion of the GIT from the oral cavity to the anus with relative rectal sparing[5].

The current treatments of choice in IBD are aminosalicylates, corticosteroids and immuno-suppressants, albeit with limited remission[6]. One of the main challenges of IBD management is that most of the available therapies are associated with many adverse side effects[7]. Studies indicate that a substantial proportion of patients do not fully respond to the conventional treatments available for IBD or that its efficacy wanes over time[8]. Corticosteroid resistance was observed in around 8 to 25 % of IBD patients[9]. The availability of newly introduced drugs, and the poor acceptance of patients for surgery are the other challenges in IBD management[7]. Identifying safe and effective therapeutic agents remains an unmet need for these patients[9].

Many published researches show the effect of herbal treatments in IBD which are associated with minimal adverse effects[10]. A study by Aggarwal *et al*. suggests that, to design a safe, multi-targeted and yet affordable drug that can modify the inflammatory pathways associated with chronic diseases, turning to traditional medicine such as Ayurveda may prove beneficial. It also adds that traditional medicine can serve as a "goldmine" for novel anti-inflammatory agents in treating chronic diseases[11].

2. IBD - Ayurvedic Perspective

Although certain diseases in the classical texts of Ayurveda, such as *raktatisara*[12] (frequent stools with blood), *pravahika*[13] (characterized by frequent defecation, watery stools, mucus-stained stools, and blood-mixed stools, pain abdomen) and *vatika grahani*[14] (characterized by urgency in defecation and diarrhoea, often altered with constipation) has conventionally been correlated with IBD, a limitation of this comparison is that these disorders do not specify the presence of mucosal ulcer/ inflammation, one of the characteristic pathological hallmark of IBD, as their feature.

2.1 *Jataravrana* - A Disease which Resembles IBD in Clinical Features

Chikitsamanjari, a traditional Ayurvedic medieval literature of Kerala written in Manipravala (a judicious mixture of Malayalam and Sanskrit), describes a condition termed '*jataravrana*', which along with its associated clinical features, resembles IBD. It is mentioned in two contexts, one in the treatment of fever[15] and the other under the diseases of children[16]. It is also narrated in Yogamrita[17] (a traditional Ayurvedic treatise on medicine) and Arogyakalpadruma[18] (traditional literature on pediatrics), as *vayattilppunnu* and *koshta vrana* (*vayar* – abdomen, *koshta* - Gastrointestinal Tract (GIT), *punnu/ vrana* - ulcers).

2.1.1 Presenting Features of Jataravrana

Chikitsamanjari describes the signs and symptoms of *jataravrana* as diarrhoea/dysentery (*pokkum),* abdominal pain /tenderness (*thottal vayattil tholu nonthezhum),* fever, especially rise in temp in the lower back (*panikkum prishtabhagavum)*, coating of the tongue (*nappookkum),* cough (*kura),* bloated abdomen (*sthabdhamayi)* and pale eyes (*pachilichikkum kan)*. The text states that the presence of these features are suggestive of internal ulcers *(vrana* in *jatara*).

2.1.1.1 Pokkum (Frequent Stools)

Frequent stools/ blood-stained stools are described as one of the cardinal symptoms of *jataravrana*. In 77-82 % of the cases of IBD, diarrhoea is a hallmark symptom[19]. IBD-associated diarrhoea results from certain pathophysiological events arising from widespread and sustained mucosal inflammation. Constant inflammation of the mucosa disrupts the epithelial barrier function and intestinal ion transport and increases the accessibility of the pathogens. Significant changes in the function of epithelial ion transporters and channels lead to electrolyte retention and water accumulation in the intestinal lumen leading to diarrhoea in IBD. Based on the site and magnitude of intestinal inflammation, the severity of diarrhoea varies in IBD patients[20]. Its severity, as determined from the stool frequency and consistency, is thus considered an important determinant of the disease activity index.

2.1.1.2 Koshtavrana/ Jataravrana/ Vayattil Punnu/ Udara Punnu (Ulcers in GIT)

The text suggests the possible presence of ulcer(s) within the GIT, which forms one of the characteristic features of this disease, and therein came to be called *jataravrana*. The terms '*antara vrana*' and '*ul vrana*' ('*antara*' and '*ul*' mean 'internal'), described in Yogamrita and Arogyakalpadruma, further substantiates that the ulcers found in this disease are internal.

2.1.1.3 Panikkum prishtabhagavum (Fever/ Local Rise of Temperature in the Lower Back)

Since *jataravrana* is described in a context of explaining different types of fever, the latter can be considered a key symptom of this disorder. Fever is a cardinal sign of inflammation. A local rise of temperature in the lower back (*panikkum prishtabhagavum)* is a sign of local inflammation. Body temperature is one of the criteria for the severity of ulcerative colitis. A temperature of 37.8 ^{0}C or above is considered severe[21].

2.1.1.4 Thottal Vayattil Tholu Nonthezhum (Abdominal Pain/ Tenderness)

The term '*thottal vayattil tholu nonthezhum*' refers to pain on palpation. Inflammation is an important driver of abdominal pain in IBD. Up to 80% of IBD patients can have acute pain, especially in the context of an inflammatory flare. Chronic pain is also experienced by 30% to 50% of patients even in the relative absence of inflammation[22]. Ulcers involving the deeper linings of the gastrointestinal tract are responsible for such pain (*vayattil novu*).

2.1.1.5 Nappookkum (Coating of the Tongue)

Nappookkum was a then colloquial term used which is a blend of the two words '*navu*', meaning tongue, and '*pooppal*', meaning fungus. Thus, the term *nappookkum* was used to denote the coating of the tongue, resembling a fungal infestation of the tongue. According to Ayurvedic concepts, the coating of the tongue is an indication of the dysfunction of biological fire *(agni*) and digestion. It is a sign of fever (*jwara*) and anaemia (*pandu*) as well. Since *koshta* (GIT) is a continuous tract that extends from the mouth to the anus, the pathological conditions of one part of the tract may affect the other which accounts for the changes observed in the tongue. Oral lesions can occur in IBD with a prevalence of about 5% – 50%. While some of these lesions are the primary IBD lesions involving the mouth, other lesions result from nutritional deficiencies secondary to malabsorption[23]. A study by Elahi *et al.* shows a statistically significant relationship among oral ulcers (0.001), halitosis (<0.0001), and coating of the tongue (<0.0001) in severe cases of UC[24].

2.1.1.6 Kura (Cough)

Cough, as well, is included as a symptom of *jataravrana*. In the classical texts of Ayurveda, the association between GIT (*koshta*) and respiratory diseases is well explicated in the description of the etiopathogenesis of bronchial asthma (*swasa*).

Inflammation of pharyngeal mucosa may cause cough. Cough can present as an extra-intestinal manifestation of IBD. The pathophysiological mechanism for this association has not been fully elucidated. Histological changes in respiratory tissues appear to mirror those in the gut, which include neutrophilic infiltrates, changes in epithelium and destruction of subepithelial glands. The common embryological origin of both the lung and the gut tissue has led to the suggestion that sensitization of gut tissue to antigens evokes an inflammatory response in other similar tissues. Alternatively, a common antigen which is both inhaled and ingested could sensitize lymphoid tissue in both the lung and the gut leading to inflammation[25].

2.1.1.7 Stabdhamayi (Bloated Abdomen)

The literal meaning of the term 'stabdhamayi' is 'to become motionless/stand-still', which probably indicates a bloated abdomen. Despite adequate treatment, a subgroup of IBD patients exhibits persistent bloating, which may not always be related to mucosal damage.

2.1.1.8 Pachilichikkum Kan (Pale Eyes)

'Pachilichikkum kan' is a then colloquial term conveying the paleness of eyes.

Pale eye is a sign of anaemia due to frequent blood loss through stools. In up to 90% of cases, iron deficiency anaemia can occur in IBD secondary to malnutrition, which in turn affects the quality of life both during the active phase and remission[26]. Many children present with non-classic symptoms of IBD, such as poor growth and anaemia.

2.1.2 Correlating Jataravrana to IBD

The comparative clinical features between IBD and *Jataravrana* is shown in Table 1.

2.2 Management of *Jataravrana* in Chikitsamanjari

Being a traditional regional literature, Chikitsamanjari relates the classical treatment principles in Ashtangahridaya (a classical text of Ayurveda) to its application in the practicing field. It describes various traditional formulations in treating common disorders and serves as a handbook for the practitioners. In the management of *jataravrana*, many internal medications in the form of various drug formulations and an external procedure are mentioned.

Table 1. Comparison of clinical features of IBD and *Jataravrana*

Inflammatory bowel disease	***Jataravrana***
Clinical features	
Persistent/recurrent bloody/mucous stools.	*Pokkum* (frequent stools/bloody stools)
Abdominal pain/cramps (Common in Crohn's disease)	*Vayattil novu* (abdominal pain)
Bloated abdomen/abdominal distension	*Stabdhata (udara stabdhata* – bloated abdomen*)*
Other Systemic features	
Fever	*Jwara* (fever)
Anaemia	*Pachilichikkum kan* (pale eyes)
Malaise	
Loss of appetite	*Agnimandya* (decreased ability to digest)
Extra-intestinal lesions	
Oral lesions	*Nappookkum* (coating of the tongue)
Arthritis	-
Sacro-ilitis	-
	Panikkum prishtabhagavum (local rise in temperature in the lower back)
Histological changes	
Mucositis, Ulcers	*Jataravranam/koshta vranam* (ulcers in GIT)
Laboratory and Endoscopic features	
Rise in ESR and CRP, decrease in hemoglobin Erythema, erosions, ulcerations Cobblestone appearance (Crohn's)	-

2.2.1 Internal Formulations

Eight internal formulations, with a total of 23 drugs, are described in the management of *jataravrana* under two chapters – *jwara chikitsa* (management of fever) and *bala chikitsa* (management of diseases in children). The dosage forms used in the treatment are *ghrita* (ghee), *taila* (oil) to use internally, and *khala* (medicated buttermilk) while carefully omitting *kasaya* (decoction), *choorna* (powder), and *arista/asava* (fermented formulations) as these possibly cause mucosal irritation.

2.2.1.1 Formulations for Jataravrana Mentioned under the Managent of Fever and Diseases of Children

Formulation 1

Medicated oil prepared using the crushed juice of *tuva (Tragia involucrate) – T. involucrata)*; *vempada* (*Ventilago madraspatana – V. madraspatana)* and *manjal* (*Curcuma longa – C. longa)* as *kalka* (paste) and sesame oil/ghee as oil base heals the ulcers in the *koshta*[27].

2.2.1.1.1 Analysis of drugs and Supporting Research Studies

Only three drugs are used in this formulation. Each of these addresses a specific symptom. Here the drugs which improve appetite, cure diarrhoea and fever, heal ulcers and reduce inflammation are logically selected and combined. A Focus Group Discussion on the role of the text Chikitsamanjari in current clinical practice revealed that this formulation has been in use as a traditional remedy for *jataravrana*[28].

2.2.1.1.2 Tuva (T. involucrata)

Properties of *T. involucrata* as described in Ayurvedic texts are given in Table 2. The plant *tuva* is also commonly known as *kodutuva* in Malayalam. Termed *dusparsa* in Sanskrit, it is extensively described in the classical texts particularly in the management of lower gastrointestinal disorders, including haemorrhoids and various kinds of diarrhoea/dysentery. The anti-inflammatory, anti-microbial, antipyretic, antioxidant and analgesic activities of *T. involucrata* has been proved in many researches (Table 3).

2.2.1.1.3 Manjal (C. longa)

Properties of *C. longa* as described in Ayurvedic texts are given in Table 2. The role of *C. longa* in reducing the inflammation and healing the ulcers of GIT has been proved in many researches[35,36]. Curcumin, a bioactive substance derived from *C. longa*, interacts with many cellular targets and might be a safe and effective therapy for inducing or maintaining UC remission[38] (Table 3).

2.2.1.1.4 Vempada (V. madraspatana)

Properties of *V. madraspatna* as described in Ayurvedic texts are given in Table 2. Classical texts do not mention the drug *V. madraspatna*. But, it is used in the management of certain diseases described in regional literature of Kerala. Anti-microbial, antioxidant and anti-inflammatory activities of the hexane extract of the root of *V. madraspatana* have been proven[39]. Each of these formulations is multi-targeted with the component drugs addressing different pathologies/symptoms of the disorder. Possible actions of each drug in Formulation 1 are shown in Table 4.

2.2.1.2 Formulation 2

Medicated ghee prepared from *pachamanjal (C. longa*), *puliyaral* (O*xalis corniculata – O. corniculata*), *trittavu* (*Ocimum sanctum – O. sanctum*), root and flower of *techi* (*Ixora coccinea – I. coccinea*-), root of *tuva* (*T. involucrata)*, leaves of *pichaka (Jasminum grandiflorum – J. grandiflorum*), and *kadukka (Terminalia chebula – T. chebula)* can be prescribed in internal ulcers[40].

2.2.1.2.1 Analysis of Drugs and Supporting Research Studies

Seven drugs are included in this formulation. Drugs which are ulcer healing (*pichakathila, manjal, techiveru, techippovu),* anti -diarrhoeal, *(puliyaral, tuva),* anti-inflammatory) *(manjal) and* antipyretic *(tulsi)* are combined here.

2.2.1.2.2 Pichakathila (J. grandiflorum)

Properties of *J. grandiflorum* as described in Ayurvedic texts are given in Table 2. The use of *Pichakathila* or the leaves of *pichakam (J. grandiflorum),* in the management of oral ulcers, is not only described in the traditional Kerala Ayurvedic literature, but is also a popular home remedy. Since it is useful in the treatment of oral ulcers, it might also play a similar role in the healing of other mucosal ulcers including intestinal ulcers.

There are studies showing potent antiulcer activity of *J. grandiflorum*[41]. Its anti-inflammatory activity in IBD and other chronic inflammatory disorders through interaction with cytokines and other inflammatory mediators is also studied[42]. It is also found effective in accelerating oral wound healing in animals clinically and histopathologically[43] (Table 3). Further studies on *J. grandiflorum* is necessary to justify its role in the management of intestinal ulcerations as well.

2.2.1.2.3 Techiveru, Techippoovu (Root and flower of I. coccinea)

Properties of *I. coccinea* as described in Ayurvedic texts are given in Table 2. Traditional Ayurvedic literature of Kerala describe the use of *I. coccinea* in the management of various disorders, including discharge associated with vaginitis/cervicitis and healing of certain ulcers. Hence, the use of *I. coccinea* in IBD, which is also characterized by inflammation of the mucosa, may be justified.

The antimicrobial, wound healing and anti-diarrhoeal activities of *I. coccinea* has been proven in different researches[44,45]. Studies also show that the leaves of *I. coccinea* possess analgesic, anti-inflammatory, and antipyretic activities[46] (Table 3).

2.2.1.2.4 Puliyaral (O. corniculata)

Properties of *O. corniculata* as described in Ayurvedic texts are given in Table 2. *O. corniculata* is a drug often described in classical texts in the management of *atisara* (diarrhoea/dysentery) and conditions such as *grahani* (irritable bowel syndrome). *O. corniculata* is known to have *in vitro* anti-bacterial and *in vivo* anti-colonizing effect[47] (Table 3).

2.2.1.2.5 Trittavu/Tulsi (O. sanctum)

Properties of *O. sanctum* as described in Ayurvedic texts are given in Table 2. Described as a drug with antipyretic property, *O. sanctum* is traditionally being used as a single drug home remedy in treating different types of fever, including *visamajwara*. (intermittent fever). *O. sanctum* possesses anti-inflammatory, analgesic and antipyretic properties[48] and is also known to be effective against gastric ulcer[49] (Table 3).

2.2.1.2.6 Kadukka (T. chebula)

Properties of *T. chebula* as described in Ayurvedic texts are given in Table 2. *Kadukka* or *T. chebula,* being one among the *triphala* (a group of three fruits, the other two being *Embilica officinalis* and, *Terminalia bellerica*) is well

known for its anti-inflammatory action. It is a potent anti-oxidant. It is known to inhibit inflammatory mediators and found to reduce the severity of trinitrobenzene sulfonic acid-induced colitis[50,51] (Table 3). Possible actions of each drug in formulation 2 are shown in Table 4.

2.2.1.3 Formulation 3

Buttermilk medicated with *jeeraka* (*Cuminum cyminum – C. cyminum), tulsi (O. sanctum), nelliphalam (Emblica officianalis – E. officinalis), techi (I. coccinea), manjal (C. longa), puliyaral (O. corniculata),* root of *tuva (T. involucrata)* and leaves of *anupanachi (Bridelia scandens)* cures internal ulcers[52].

This formulation consists of eight drugs, of which *O. corniculata, T. involucrata, and C. cyminum* are anti-diarrhoeal. *C. cyminum* is carminative and relieves abdominal pain. *O. sanctum* is anti-pyretic while *I. coccinea* and *B. stipularis* are anti-ulcerative.

2.2.1.3.1 Analysis of Drugs and Supporting Studies

2.2.1.3.1.1 Anupanachi/Balapanachi/Cherupanachi (B. stipularis/B. scandens)

Properties of *B. stipularis* as described in Ayurvedic texts are given in Table 2. *Anupanachi* is widely advised in the medical literature of Kerala for both internal and external ulcers, skin diseases and fever. It is also advised as a single drug. Drinking water medicated with it is recommended in the management of ulcers. Although there exists a difference of opinion in the botanical identification of this drug, it is often identified and accepted as *B. stipularis/ B. scandens* among the Ayurvedic physicians of Kerala.

2.2.1.3.1.2 Jeeraka (C. cyminum)

Properties of *C. cyminum* as described in Ayurvedic texts are given in Table 2. Kerala traditional literature recommends the use of *jeeraka* in the management of many diseases in infants and children. It is also used in the treatment of various gastrointestinal disorders, including indigestion, diarrhoea, bloating, flatulence etc. Its anti-diarrhoeal activity is proven in different studies[53] (Table 3).

2.2.1.3.1.3 Nelliphalam (E. officinalis)

Properties of *E. officinalis* as described in Ayurvedic texts are given in Table 2. *Nelliphalam,* i.e. the fruit of *nelli* or Indian gooseberry, is one among the drugs considered to have superior value among the medicinal herbs, especially for its role in nourishment and building up of vitality and vigor. It is proven to ameliorate the severity of acetic acid-induced colitis[54]. In a recent study it has been enumerated as a potential novel treatment for inflammatory bowel disease[55] (Table 3).

In this formulation, buttermilk is the medium for drug administeration. Medicated buttermilk improves digestive power. The action of buttermilk on gut micro-biome is another area of interest in research. Butter milk is a modulator of gut micro-biome. Possible actions of each drug in formulation 3 are shown in Table 4.

2.2.1.4 Formulation 4

Ghee prepared with *nellikka (E. officianale), techiveru (*root of *I. coccinea), dusparsa (T. involucrata), ayamodakam (Trachyspermum roxburghianum – T. roxburghianum), jeerakam (C. cyminum), veppinthol (*bark of *Azadirachta indica – A. indica)* and buttermilk is beneficial in *udara vrana*[56].

2.2.1.4.1 Analysis of Drugs and Supporting Studies

2.2.1.4.1.1 Ayamodaka (T. roxburghianum)

Properties of *T. roxburghianum* as described in Ayurvedic texts are given in Table 2. According to Ayurvedic texts, *T. roxburghianum* has carminative properties. But there is a lack of research studies supporting this carminative action or anti-inflammatory action.

2.2.1.4.1.2 Veppu (A. indica)

Properties of *A. indica* as described in Ayurvedic texts are given in Table 2. The well-known effects of *A. indica* in health and wellness, including its anti-inflammatory, antioxidant, antibacterial, antiviral and anticancer properties, can be ascribed to the presence of different bioactive constituents. Nimbolide, a limonoid extracted from *A. indica*, is suggested as a potential new treatment for IBD[57] (Table 3). Possible actions of each drug in formulation 4 are shown in Table 4.

2.2.1.5 Formulation 5

A paste of *muttil* (*Centella asiatica – C. asiatica)*, *puliyaral* (*O. corniculata), techipoovu (I. coccinea), balapanachi (B. stipularis),* leaves of *tulsi (O. sanctum), jeeraka (C. cyminum)* and *nisa (C. longa)* in raw buttermilk is said to stimulate appetite, heal ulcers, and cure cough, abdominal pain and fever[58]. Thus, this formulation is said to have

broader effects owing to its action on the associated symptoms of *jataravrana*.

2.2.1.5.1 Analysis of Drugs and Supporting Studies

2.2.1.5.1.1 Muttil (C. asiatica)

Properties of *C. asiatica* as described in Ayurvedic texts are given in Table 2. *C. asciatica*, known locally as *muttil/kudangal/kudakan*, well known for its effects in neuroprotection and cognitive enhancement, is also said to be an effective anti-inflammatory and antipyretic drug. Madecassic acid, the principal active ingredient of *C. asiatica,* through its action on various cellular pathways, is responsible for its anti-colitis action[59,60] (Table 3). Possible actions of each drug in formulation 5 are shown in Table 4.

2.2.1.6 Formulation 6

Tila taila (sesame oil) medicated with *pachilaperumal*, (controversial identity), *anayadiyan* (*Elephantopus scaber - E. scaber), cherupanachi (B. stipularis)*, *karikkin vellam* (tender coconut water), and *chakiricharu* (juice of coconut husk) heals ulcers in *koshta*[61].

2.2.1.6.1 Analysis of Drugs and Supporting Studies

2.2.1.6.1.1 Pachilaperumal

The botanical identification of *Pachilaperumal* is controversial. One of the suggested identifications is *Seidenfia rheedei*.

2.2.1.6.1.2 Karikkin vellam (Tender Coconut Water), Chakiri (Coconut Husk)(Cocos nucifera – C. nucifera)

Properties of *C. nucifera* as described in Ayurvedic texts are given in Table 2. Two products of *C. nucifera* are prescribed in this formulation – *karikkin vellam* (tender coconut water) and *chakiricharu* (juice of coconut husk). Although the properties of tender coconut water are described in the classical texts, its usage as a drug in the management of various disorders is given by the medieval regional literature of Kerala. It is known to possess antioxidant and anti-inflammatory properties[62]. The use of *chakiricharu*, an innovative application described in many regional medieval literature of Kerala, is also worth mentioning.

2.2.1.6.1.3 Anayadiyan (E. scaber)

Properties of *E. scaber* as described in Ayurvedic texts are given in Table 2. *E. scaber* is known locally as *anayadiyan/anachuvadi* (*ana* – elephant, *chuvadu* – foot) due to its appearance resembling an elephant's foot. It possesses anti-inflammatory activity through inhibition of cellular pathways, including the production of nitric oxide and NF-κB p65-DNA binding in lipo-polysaccharide-stimulated macrophages[63]. Its antimicrobial, antioxidant, analgesic, and wound healing abilities have also been reported in various research articles[64] (Table 3). Possible actions of each drug in formulation 6 are shown in Table 4.

2.2.1.7 Formulation 7

Ghee medicated with *kalka* (paste) of *yasti* (*Glycyrrhiza glabra – G. glabra)* and *jeeraka* (*C. cyminum)* in expressed juice of *pookkula* (inflorescence of coconut) is said to cure *jataravrana*[65].

2.2.1.7.1 Analysis of Drugs and Supporting Studies

2.2.1.7.1.1 Yasti (G. glabra)

Properties of *G. glabra* as described in Ayurvedic texts are given in Table 2. Classified under *sandhaneeya* (wound healing) group of drugs in the classical literature, *yasti* or *G. glabra,* is often used in wound and ulcer healing, and is also described to be an analgesic. Licoflavone, the major component of *G. glabra,* is responsible for its anti-ulcer properties[66]. It is known to have a protective action on the integrity of the intestinal epithelial barrier[67] (Table 3).

2.2.1.7.1.2 Pookkula (Inflorescence C. nucifera)

Inflorescence of coconut is widely used in post-partum care and in various gynaecological disorders including menorrhagia and leucorrhea. Traditional Kerala Ayurveda texts also advices the local application of juice of immature inflorescence in the management of oral ulcers. It is proven to have anti-inflammatory and anti-nociceptive properties[68]. It is also an antioxidant and possesses anticancer activity[69]. Possible actions of each drug in formulation 7 are shown in Table 4.

2.2.1.8 Formulation 8

Ghee prepared with juice of *tuva* (*T. involucrata), nisa (C. longa), pata (Cyclea peltata - C. peltata), techi (I. coccinea)* and *kalka* (paste) of *vettila* (leaves of *Piper betel - P. betel)* in expressed juice of *cherukadaladi* (*Cyathula prostrata - C. prostrata)* is useful in *udarappunnu* and blood mixed stools[70].

Table 2. Details of the individual drugs in the formulations

Drug name as given in the formulation	Botanical name	Actions described in Ayurveda texts which might impact the symptomatology of IBD
Tuva (Indian stinging nettle)	*Tragia involucrata*	*atisara – arsas – jwara hara, dipana, pachana**
Manjal (Turmeric)	*Curcuma longa*	*sopha-vrana-pandu hara,*
Vempada (Red creeper)	*Ventilago madraspatana*	*dipana, ruchya, vrana - gulmashoola hara*
Pichakathila (a type of Jasmine)	*Jasminum grandiflorum*	*vranaropana, mukhapakahruth*
Techiveru (root of Sacred Ixora)	*Ixora coccinea*	*jwara – atisara –gulmasulahara, vranaropana*
Techipoovu (flower of Sacred Ixora)	*Ixora coccinea*	*grahi, dipana, pachana*
Puliyaral (Indian sorrel)	*Oxalis corniculata*	*ruchya, dipana, , jwara – grahani – arsa – atisara samana*
Trittavu/Tulsi (Sacred basil)	*Ocimum sanctum*	*dipana, jwara – kasa hara*
Kadukka (Myrobalan)	*Terminalia chebula*	*dipana, vranaropana, sophahara, atisara –jwara - mukharoga – vibandhahara*
Anupanachi/ balapanachi	*Bridelia stipularis / Bridelia scandens*	*vrana – jwara hara*
Jeeraka (Cumin seed)	*Cuminum cyminum*	*dipana, pachana, ruchya, grahi, jwara – aadhmana - gulma - atisara samana*
Nellibhalam/Nellikka (Indian gooseberry)	*Emblica officinalis*	*jwaraghna, sophahara, adhmana hara*
Ayamodaka (Ajowan)	*Trachyspermum roxburghianum*	*dipana, ruchya, kaphavata hara, gulmasula - adhmana hara*
Veppinthol (bark of Neem tree)	*Azadirachta indica*	*ruchya, kasa - jwara – vrana hara,*
Muttil (Indian pennywort)	*Centella asiatica*	*ruchya, , jwara-kasa hara, sophahara*
Anayadiyan (Prickly-leaved elephant's foot)	*Elephantopus scaber*	*grahanihara, , kasa-vrana - jwara hara*
Chakiri (Coconut husk)	*Cocos nucifera*	*dipana, grahani samana*
Thenginpookkula (Inflorescence of coconut)	*Cocos nucifera*	*shrama shoshahara*
Yasti (Liquorice)	*Glycyrrhiza glabra*	*vrana – sophahara, raktapittahara*
Cherukadaladi (Prostrate Pasture weed)	*Cyathula prostrata*	*grahi, vranahara*
Padakkizhangu (root of Pata/ Indian moon-seed)	*Cyclea peltata*	*pachana, atisara - jwara – vrana hara, sulahara*
Vetila (Betel leaf)	*Piper betel*	*dipana,*

**atisarahara* – anti diarrhoeal/ anti-dysenteric, *arsohara* - anti haemorrhoid, *jwarahara* – antipyretic, *dipana* -increases digestive power, *pachana* - digestive, *vranahara* - anti-ulcerative, *pandu hara* – cures anaemia, *ruchya* – increases palatability, *gulmasula hara* - relieves abdominal pain, *vranaropana* - ulcer healing, *mukhapakahruth* - cures stomatitis/ aphthous ulcer, *grahi* – hardens stool, *kasahara* - cures cough, *sophahara* - anti-inflammatory, *gulma/ vibandha/ adhmana hara* - cures bloating of the abdomen, *shrama shoshahara* – alleviates malaise, *sulahara* - analgesic.

2.2.1.8.1 Analysis of Drugs and Supporting Studies

2.2.1.8.1.1 Vettila (P. betel)

Properties of *P. betel* as described in Ayurvedic texts are given in Table 2. *P. betel* is carminative, stimulant, astringent and effective against parasitic worms. Experimental studies show that *P. betel* possesses antioxidant, anti-inflammatory, immunomodulatory, antiprotozoal, free radical scavenging, anticaries, anti-ulcer, gastroprotective effects and chemo-preventive activities[71-73] (Table 3).

2.2.1.8.1.2 Pata (C. peltata)

Properties of *C. peltata* as described in Ayurvedic texts are given in Table 2. Many formulations advised for *atisara*

(dysentery/diarrhoea) in classical texts of Ayurveda contain *C. peltata*. It is a potent anti-ulcerative, antipyretic and analgesic[74,75]. Its anti-inflammatory activity is due to the synergistic activity of bioactive molecules like tetrandrine present in it[76] (Table 3).

2.2.1.8.1.3 Cherukadaladi (C. prostrata)

Known as *raktapamarga* in Sanskrit, *C. prostrata* is used singly as well as with other drugs in the management of gastrointestinal disorders such as dysentery and hemorrhoids. It possesses anti-inflammatory, antioxidant and analgesic activities[77]. Possible actions of each drug in formulation 8 are shown in Table 4.

Table 3. The possible mechanisms of action of the drugs in IBD

Drug	Researches and their Findings	
	Research Study	**Findings**
Tuva *(Tragia involucrata)*	Ethnopharmacological Use and Biological Activities of *T. involucrata L*[29].	Evaluates the anti-inflammatory, anti-microbial, and antipyretic activities of *T. involucrata.*
	Screening of wild plant species for antibacterial activity and phytochemical analysis of *Tragia involucrata* L[30].	Concludes the anti-bacterial activity of acetone extract of *T. involucrata.*
	Identification of Phytoconstituents of *Tragia involucrata* leaf Extracts and Evaluate their Correlation with Anti-inflammatory and Antioxidant Properties[31].	Evaluates the antioxidant and anti-inflammatory properties of ethyl acetate and petroleum ether leaf extracts of *T. involucrata.*
	Methanol, ethyl acetate and n-hexane extracts of *Tragia involucrata* L. leaves exhibit anxiolytic, sedative and analgesic activity in Swiss albino mice[32].	Shows the analgesic, sedative and anxiolytic activity of leaf extract of *T. involucrata*. States that the febrifuge action of *T. involucrata* could be mediated through its anti-inflammatory and anti-microbial activities.
	Psychopharmacological studies on *Tragia involucrata* root extract[33].	Concludes that the root extract of *T. involucrata* has a significant depressant effect on the central nervous system, thereby decreasing the body temperature.
	Mechanistic insights from the review and evaluation of ayurvedic herbal medicines for the prevention and management of COVID-19 patients[34].	Due to its antipyretic activity, Ayurvedic formulation to protect against COVID-19 recommended by the Ministry of AYUSH, Government of India, contains the extract of *T. involucrata.*
Manjal *(Curcuma longa)*	Uncovering the Mechanism of Curcuma in the Treatment of Ulcerative Colitis Based on Network Pharmacology, Molecular Docking Technology, and Experiment Verification[35].	Proves the role of *C. longa* in reducing the inflammation and healing the ulcers of GIT.
	Curcumin use in ulcerative colitis: is it ready for prime time? A systematic review and meta-analysis of clinical trials[36].	Proves the role of *C. longa* in reducing the inflammation and healing the ulcers of GIT.
	Curcumin and Its Modified Formulations on Inflammatory Bowel Disease (IBD): The Story So Far and Future Outlook[37].	States that curcumin interacts with many cellular targets (NF-κB, JAKs/STATs, MAPKs, TNF-γ, Interleukin (IL)-6, PPARγ, and TRPV1) and reduces the progression of IBD.
	The Use of Curcumin as a Complementary Therapy in Ulcerative Colitis: A Systematic Review of Randomized Controlled Clinical Trials[38].	States that curcumin might be a safe and effective therapy for inducing or maintaining UC remission along with standard treatments.
Vempada (*Ventilago madraspatana)*	Evaluation of nitric oxide scavenging activity, *in vitro and ex vivo*, of selected medicinal plants traditionally used in inflammatory diseases[39].	Proves the anti-microbial, antioxidant and anti-inflammatory activities of the hexane extract of the root of *V. madraspatana*.

Table 3 to be continued...

Drug	Researches and their Findings	
	Research Study	**Findings**
Pichakathila (*Jasminum grandiflorum)*	Antiulcer and *in vitro* antioxidant activities of *Jasminum grandiflorum* L[41].	Shows that the leaves of *J. grandiflorum* (70% ethanolic extract) possess potent anti-ulcer activity, which may be attributed to its antioxidant action.
	Anti-inflammatory activity of *Jasminum grandiflorum* L. subsp. *floribundum* (Oleaceae) in inflammatory bowel disease and arthritis models[42].	*J. grandiflorum* successfully reduced the expression of pro-inflammatory cytokines and inflammatory mediators. Methanolic extract of *J. grandiflorum* and its fractions showed inhibitory activity on the enzymes cyclooxygenases and lipoxygenases involved in synthesizing inflammatory mediators. The study recommends the use of this extract in the management of chronic inflammatory disorders.
	Formulation of a Jasminum grandiflorum containing mucoadhesive and evaluation of its healing effect on oral biopsy ulcers[43].	Mucoadhesive containing *J. grandiflorum* leaves showed that it was more effective than the placebo in accelerating oral wound healing in animals clinically and histopathologically
Techiveru/ Techippovu (*Ixora coccinea)*	Can scientific evidence support using Bangladeshi traditional medicinal plants in the treatment of diarrhoea? A review on seven plants[44].	Shows the anti-diarrhoeal effect of *I. coccinea*.
	Antidiarrhoeal activity of flowers of *Ixora Coccinea Linn*. in rats[45].	Concludes that the aqueous extract of the flowers exhibited significant inhibition of castor oil-induced diarrhoea in rats.
	Analgesic, anti-inflammatory and antipyretic effects of *Ixora coccinea*[46].	*I. coccinea* leaves possessed analgesic, anti-inflammatory, and antipyretic activities. Chemical constituents of *I. coccinea* leaves such as flavonoids, tannins, and triterpenes in ethanol extract may be responsible for its observed biological activities.
Puliyaral (*Oxalis corniculata)*	*Oxalis corniculata* (Oxalidaceae) leaf extract exerts *in vitro* antimicrobial and *in vivo* anticolonizing activities against Shigella dysenteriae 1 (NT4907) and Shigella flexneri 2a (2457T) in induced diarrhoea in suckling mice[47].	The extract of *O. corniculata* inhibited numerous pathogenic bacteria like *Staphylococcus aureus*, *Escherichia coli* and various subgroups of Shigella through its *in vitro* anti-bacterial and *in vivo* anti-colonizing effect.
Trittavu/ Tulsi (*Ocimum Sanctum)*	Pharmacological and phytochemical evaluation of *Ocimum sanctum* root extracts for its anti-inflammatory, analgesic and antipyretic activities[48].	The ethyl acetate fraction of roots of *O. sanctum* possesses anti-inflammatory, analgesic and antipyretic properties.
	Anti-Inflammatory, gastrointestinal and hepatoprotective effects of *Ocimum sanctum Linn*: an ancient remedy with new application[49].	Shows the efficacy of *O. sanctum* against inflammatory response and gastric ulcer.
Kadukka (*Terminalia chebula)*	Preparation of Herbal Formulation for Inflammatory Bowel Disease Based on *In Vitro* Screening and *In Vivo* Evaluation in a Mouse Model of Experimental Colitis[50].	*T. chebula*, along with two other herbal drugs, was found to attenuate the severity of symptoms such as weight loss, diarrhoea, and rectal bleeding, in trinitrobenzene sulfonic acid-induced colitis.
	Review and Implications of Traditional Indian Medicine for Inflammatory Bowel Disease[51].	Chebulic acid, a constituent of *T. chebula*, is found to inhibit inflammatory mediators and is an anti-oxidant.

Table 3 to be continued...

Drug	Researches and their Findings	
	Research Study	**Findings**
Jeeraka (*Cuminum cyminum)*	Anti-diarrhoeal investigation from aqueous extract of *Cuminum cyminum Linn*. Seed in Albino rats[53].	Proves the anti-diarrhoeal effects of aqueous extract of *C. cyminum* seed in albino rats.
Nelliphalam (*Emblica officinalis)*	Protective effect of *Emblica officinalis* fruit extract on acetic acid induced colitis in rats[54].	Proves the cytoprotective effects of *E. officinalis.* These were inferred from the reduced colon weight/length ratio, colon insult, and macroscopic scores for inflammation and a significant decrease in lactate dehydrogenase.
	Treatment repurposing for inflammatory bowel disease using literature-related discovery and innovation[55].	*E. officianalis* is enumerated as a potential novel treatment for inflammatory bowel disease.
Veppu (*Azadirachta indica)*	Nimbolide Inhibits Nuclear Factor-KB Pathway in Intestinal Epithelial Cells and Macrophages and Alleviates Experimental Colitis in Mice[57].	Nimbolide, a limonoid extracted from *A. indica*, inhibits NF-κB signalling in intestinal epithelial cells and macrophages and ameliorates experimentally induced colitis in mice, suggesting that nimbolide can serve as a potential new treatment for IBD.
Muttil (*Centella asiatica)*	Ethanol extract of *Centella asiatica* alleviated dextran sulfate sodium-induced colitis: Restoration on mucosa barrier and gut microbiota homeostasis[59].	Shows the anti-inflammatory effect against DSS-induced colitis, probably by restoring the mucosal barrier and gut microbiota homeostasis.
	Inhibition of the activation of γδT17 cells through PPARγ-PTEN/Akt/GSK3β/NFAT pathway contributes to the anti-colitis effect of madecassic acid[60].	Madecassic acid, the principal active ingredient of *C. asciatica*, inhibits the activation of γδT17 cells through PPARγ-PTEN/Akt/GSK3β/NFAT pathway, which contributes to the amelioration of colitis.
Karikkin vellam (*Cocos nucifera)*	Health benefits of tender coconut water[62].	States that tender coconut water possesses antioxidant and anti-inflammatory activities .
Anayadiyan (*Elephantopus scaber)*	New phenolic acids from the whole herb of *Elephantopus scaber* Linn. and their anti-inflammatory activity[63].	Compounds isolated from the whole plant of *E. scaber* exhibited anti-inflammatory activity by inhibiting the production of nitric oxide in lipopolysaccharide-stimulated macrophage cells in mouse.
	A review on pharmacology and toxicology of Elephantopus scaber Linn[64].	Shows that the ethanol extract of *E. scaber* has potent anti-inflammatory effect by inhibiting the NF-κB p65-DNA binding activity in LPS-activated macrophages. The study also reports the Antimicrobial, antioxidant, anti-inflammatory, analgesic, and wound healing abilities.
Yasti (*Glycyrrhiza glabra)*	Anti-ulcer effect and potential mechanism of licoflavone by regulating inflammation mediators and amino acid metabolism[66].	Licoflavone is the main component of Glycyrrhiza responsible for its anti-ulcer properties. It alleviates gastric ulcers by regulating the inflammatory mediators and the amino acid metabolism.
	A flavonoid rich standardized extract of *Glycyrrhiza glabra* protects intestinal epithelial barrier function and regulates the tight-junction proteins expression[67].	Concludes the protective action of a flavonoid-rich extract of *G. glabra* on the integrity of the intestinal epithelial barrier, thereby indicating its potential in protecting from the consequences of leaky gut.

Table 3 to be continued...

Drug	Researches and their Findings	
	Research Study	**Findings**
Pookkula (Cocos nucifera)	*In vitro* antioxidant, anti-inflammatory and anticancer activities of ethyl acetate soluble proanthocyanidins of the inflorescence of *Cocos nucifera* L[68].	Proves the antioxidant, anti-inflammatory and anticancer activities of ethyl acetate soluble proanthocyanidins (EASPA) of immature inflorescence of *Cocos nucifera*.
	Phenolic rich *Cocos nucifera* inflorescence extract ameliorates inflammatory responses in LPS-stimulated RAW264.7 macrophages and toxin-induced murine models[69].	Suggests that acetone extract of *C. nucifera* has significant anti-inflammatory and anti-nociceptive properties, mainly attributed to the inhibition of NF-κB/IκB signalling cascade.
Vettila (*Piper betel)*	Healing property of the Piper betel phenol, allylpyrocatechol against indomethacin-induced stomach ulceration and mechanism of action[71].	Allyl pyrocatechol, the major antioxidant constituent of *P. betel*, heals indomethacin-induced gastric ulceration in the rat due to its antioxidative and mucin-protecting properties.
	Piper betle (L): Recent Review of Antibacterial and Antifungal Properties, Safety Profiles, and Commercial Applications[72].	States that betel leaf extract, essential oil, preparations, and isolates could inhibit microbial growth, including multidrug-resistant bacteria.
	The phytochemistry, traditional uses and pharmacology of *Piper Betel*. linn (Betel Leaf): A pan-asiatic medicinal plant[73].	States the antioxidant, anti-inflammatory, immunomodulatory, antiprotozoal, free radical scavenging, anticaries, anti-ulcer, gastroprotective effects and chemopreventive activities of *P. betel.*
Pata (*Cyclea peltata)*	Gastric antisecretory and antiulcer activities of *Cyclea peltata* (Lam.) Hook. f. and Thoms. in rats[74].	Shows that the ethanolic extract of *C. peltata* has potent antisecretory and anti-ulcer properties.
	Comparative antipyretic and analgesic activities of *Cissampelos pareira* Linn. and *Cyclea peltata* (Lam.) Hook. F. and Thomas[75].	Reports the antipyretic and analgesic effect.
	Bioassay guided fractionation of *Cyclea peltata* using *in vitro* RAW 264.7 cell culture, antioxidant assays and isolation of bioactive compound tetrandrine[76].	Observes that the anti-inflammatory activity of the alkaloid fraction of *C. peltata* may be due to the synergistic activity of bioactive molecules like tetrandrine present in it.
Cherukadaladi (Cyanthula prostrata)	Antiinflammatory, analgesic and antioxidant activities of *Cyathula prostrata* (Linn.) Blume (Amaranthaceae)[77].	The results concludes that methanolic extract of *C. prostrata* possess anti-inflammatory and analgesic activities.

2.2.2 External Procedure

Besides the above internal formulations, certain external procedures are described in managing *jataravrana*. *Takradhara* (*takra* – buttermilk, *dhara* – an external procedure of pouring medicated liquids) over the head or whole body, medicated with *thenginpookkula* (inflorescence of *C. nucifera*) and *nellikka* (*E. officinalis*), is one such procedure. The use of *sirodhara* (pouring medicated liquids over the head) and *sarvangadhara* (pouring medicated liquid over the whole body) in treating *jataravrana*, a GI disorder, is of special mention. Studies have shown that poor mental health is often associated with disease flares and therefore a poorer prognosis. Psychological stress plays a role in the pathophysiology of some functional and chronic inflammatory gastrointestinal conditions[78]. Stress enhances the production of catecholamines by activating the sympathetic system, which in turn produces inflammatory mediators. The vagus nerve has anti-inflammatory effects, which are inhibited by stress, thereby leading to an enhanced systemic inflammatory response to endotoxin and intestinal inflammation. Chronic stress increases sensitivity to colitis via immune system dysfunction and disruption of gut microbiota. Changes in tissue levels of neurotransmitters have also been demonstrated in patients with IBD[79]. The role of *sirodhara* in the management of IBD may be through its effect on relieving stress.

Table 4. Actions of various drugs in the each formulation

	Antidiarrhoeal (*atisaraghna*)	**Antipyretic (*jwaraghna*)**	**Antiulcer (*vranahara*)**	**Anti-inflammatory (*sophahara*)**	**Anti- bacterial/ Anti- microbial**	**Analgesic (*vedanahara*)**	**Appetizer**	**Drug with proven action in IBD/ colitis**
Formulation 1	*T. involucrata*	*T. involucrata* *C. longa*	*V. madraspatana* *C. longa*	*T. involucrata* *C. longa*	*V. madraspatana* *T. involucrata* *C. longa*	*T. involucrata*		*C. longa*
Formulation 2	*O. corniculata* I. coccinea	*O. sanctum* *O. corniculata* I. coccinea	*O. sanctum* *J. grandiflorum*	*O. sanctum* I. coccinea *J. grandiflorum*	*O. corniculata* I. coccinea	*O. sanctum* I. coccinea	*O. sanctum*	*J. grandiflorum*
Formulation 3	*C. cyminum* *T. involucrata,* I. coccinea *O. corniculata*	*T. involucrata* *C. longa* I. coccinea *O. corniculata*	*B. stipularis* *O. sanctum* *C. longa*	*E. officianalis* *T. involucrata* *O. sanctum* *C. longa*	*T. involucrata* *C. longa* I. coccinea *O. corniculata*	*T. involucrata* *O. sanctum* I. coccinea		*E. officianalis* *C. longa*
Formulation 4	*C. cyminum* *T. involucrata* I. coccinea	*T. involucrata* I. coccinea	*A. indica* I. coccinea	*E. officianalis T. involucrata*	*T. involucrata* I. coccinea	*T. involucrata* I. coccinea		*E. officianalis* *A. indica*
Formulation 5	*O. corniculata* I. coccinea *C. cyminum*	*O. sanctum,* *O. corniculata* I. coccinea *C. longa*	*O. sanctum* *C. asiatica* *C. longa*	*O. sanctum* I. coccinea *C. asiatica* *C. longa*	*O. corniculata* I. coccinea *C. longa*	*O. sanctum* I. coccinea	*O. sanctum*	*C. asiatica* *C. longa*
Formulation 6		*B. stipularis*	*E. scaber* *B. stipularis*	*C. nucifera* *E. scaber*	*E. scaber*	*C. nucifera* *E. scaber*	*O. sanctum*	
Formulation 7	*C. cyminum*		*G. glabra*	*C. nucifera* *G. glabra*	*G. glabra*	*C. nucifera*		*G. glabra*
Formulation 8	*T. involucrata* *C. peltata*	*T. involucrata* *C. longa* *C. peltata*	*C. peltata* *C. longa* *P. betel*	*T. involucrata* *C. longa* *C. peltata* *P. betel*	*P. betel* *T. involucrata* *C. longa*	*T. involucrata* *C. peltata*		*C. longa*

3. Discussion

The clinical features of certain diseases mentioned in classical texts of Ayurveda, such as *pravahika, raktatisara and vatika grahani,* resemble IBD. But, mucosal ulcer (*koshta vrana/jataravrana*), one of the characteristic histopathological changes associated with IBD, is not mentioned as a feature in any of these diseases. However, traditional medieval Ayurveda literature of Kerala describes a disorder termed *jataravrana*, the features of which resembles IBD, including the presence of mucosal ulcer. Although mucosal ulcers can also occur in a number of other diseases such as peptic ulcers, intestinal tuberculosis and late stages of typhoid; considering the symptoms and signs associated with *jataravrana*, such as diarrhoea /dysentery, fever, abdominal pain, coating of the tongue, and pale eyes, *jataravrana* has a greater inclination towards IBD.

The line of treatment for any disease in Ayurveda targets its specific pathology (*samprapthy vighatanam*) and clinical features (*ruk pratikriya*). Following this general line of treatment, management of *jataravrana* also aims to correct its etiopathology, which is impaired biological fire (*agni)* and addresses the clinical features which are ulcers, diarrhoea, fever and pain. Ayurveda also recommends a combination of drugs (formulations) in the treatment of diseases. A close observation of such combinatory formulations described in the management of *jataravrana* reveals that each formulation contains drugs with varying mechanisms of action, including anti-ulcerative (*vranaropana*), anti-diarrhoeal (*atisaraghna*), anti-inflammatory (*sophahara*), antipyretic (*jwarahara*) and analgesic (*vedanahara*). It is notable that a drug(s) with anti-ulcerative property is present in each of these formulations, possibly suggesting the presence of an ulcer as a frequent/ common symptom in this disorder. In modern medicine as well, achieving intestinal mucosal healing has been the current aim in the management of IBD and is considered a robust target and a clinical end-point for more recent drug trials. Studies have shown that treatments which ensure complete mucosal healing have a positive impact on the course of the disease. It reduces the number of clinical relapses, hospitalizations and surgical interventions[80].

Among the 23 drugs mentioned in the total eight formulations in *jataravrana chikitsa*, extracts of six drugs *C. longa*, *G. glabra, E. officianalis, C. asciatica, A. indica and J. grandiflorum* are found to have proven action in IBD/colitis. Twelve drugs *T. involucrata, C. longa, C. peltata, P. betel, C. nucifera, G. glabra, E. scaber, I. coccinea, J. grandifolium, E. officianalis, C. asciatica* and *O. sanctum* are anti-inflammatory. *C. peltata*, *C. longa, G. glabra, B. stipularis, E. scaber, O. sanctum, V. madraspatana, J. grandifolium, A. indica, P. betel* and *C. asiatica* have anti-ulcer activity. Five drugs have anti-diarrhoeal properties which include *T. involucrata, C. peltata, Ox. corniculata, I. coccinea,* and *C. cyminum*. The drugs *T. involucrata, C. longa, C. peltata, B. stipularis, O. sanctum, Ox. corniculata* and *I. coccinea* are antipyretic. *P. betel, G. glabra, T. involucrata, C. longa, Ox. corniculata, I. coccinea, E. scaber* and *V. madraspatana* possess antibacterial /antimicrobial action. Drugs *T. involucrata*, *C. peltata, E. scaber, O. sanctum, C. nucifera* and *I. coccinea* are analgesics. It is observed that in each formulation, individual drugs with the above properties have been logically selected and combined. A focus group discussion aimed at finding the effective formulations in Chikitsamanjari in current clinical practice revealed that the two formulations *tuvadi* (formulation 1 described above) and *pachamanjaladi* (formulation 2) are being used effectively in clinical presentations similar to IBD. Such combinatorial and multi-targeted approach in the management of various diseases has recently been gaining popularity and acceptance. Also, polyherbal formulations based on traditional medicine are proposed as new strategies in drug development instead of single molecule-based drugs to tackle disease complexity[81].

It is noteworthy that apart from these internal formulations, an external procedure – *dhara* is also advised in the management of *jataravrana*. *Dhara* over different parts of the body, including the head (*sirodhara*), is described. According to Labanski *et al*., the role of psychological factors, such as stress, in the pathology of many diseases, including IBD, often go unnoticed[78]. Although scientific validation is necessary to authenticate, it is possible that the use of *sirodhara* might have a role in alleviating such psychological disturbances.

4. Conclusion

Many research findings substantiate the use of various medicinal plants or their extracts in IBD. Such herbal medicines are gaining popularity among IBD patients owing to their lesser adverse effects and efficacy[10]. Due to the similarity in their pathology and clinical features, the line of treatment adopted in the management

of *jataravrana* may be extended to that of IBD. It is notable that the drugs described in the management of *jataravrana* have been logically combined so as to address various pathologies and symptoms of IBD. Researches show that such multi-ingredient traditional formulations with several bio-actives have putative synergistic activities, probably through interaction with various signalling pathways. Though these treatment principles have been used traditionally and Ayurvedic management is promising in many experimental models, it is essential to supplement it with well-designed clinical trials to define the exact role of each of these formulations in the prevention or management of IBD.

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