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Research

Potassium Salt of Boswellic Acid To Managing Hypokalemia Associated With Irritable Bowel Syndrome (IBS) During Pregnancy.

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Abstract

Triterpenoids Boswellic acids derived from the resin of Boswellia serrata have proven to be natural anti-inflammatory substances. They have the potential to inhibit 5- lipoxygenase (5-LOX) and inflammatory cytokines like TNF-α and IL-1β which are known to worsen mucosal inflammation. Irritable Bowel Syndrome (IBS) is a long-lasting disorder of the digestive system that manifests in form of abdominal discomfort, bloating, changes in bowel movement, and greatly reduced quality of life. The causes are many; however, more recent studies uncovered a contribution of systemic electrolyte imbalance, especially hypokalemia, in aggravating the inflammatory processes linked to IBS. Hypokalemia, which is a condition where serum potassium levels are less than 3.5 mmol/L, not only decreases the peristaltic movement of smooth muscles and neuromuscular transmission in the intestinal tract but leads to inflammation of the lining or mucosal membrane which tends to worsen the symptoms of IBS. Boswellic acids are pentacyclic triterpenoids extracted from the resin of Boswellia serrata that possess potent anti-inflammatory effects via 5-lipoxygenase inhibition and down regulation of pro-inflammatory cytokines. This study investigates the use of a new compound, the potassium salt of boswellic acid, which may use inflammatory aspect of boswellic acid in addition to potassium's property of mitigating electrolytic imbalance, for treating inflammation in Hypokalaemia associated Inflammatory Bowel Syndrome (IBS). In our in vitro experiments, we observed that potassium starvation greatly reduced the secretion of pro-inflammatory factors like TNF-α, IL-6, and NFκB from the intestinal epithelial cells. Furthermore, the compound appear to positively influence the tight junctions which could bolster the maintenance of intestinal barrier protection. In an initial clinical assessment of patients with hypokalemic IBS, the use of boswellic acid potassium salt over a six-week period was associated with significant worsened symptom scores, increased potassium levels, and decreased CRP examinations.

Keywords: Inflammatory, hypokalaemia, boswellic acid, inflammatory bowel syndrome (IBS), Potassium salt of beswellic acids.

INTRODUCTION

The bioactive triterpenoids Boswellic acids derived from the resin of Boswellia serrata have proven to be natural anti-inflammatory substances. They have the potential to inhibit 5- lipoxygenase (5-LOX) and inflammatory cytokines like TNF-α and IL-1β which are known to worsen mucosal inflammation in gastrointestinal disorders.Irritable Bowel Syndrome (IBS) is an intricate persistent disorder of the gastrointestinal tract, with symptoms such as abdominal pain, bloating, and changes in bowel movements that may manifest as diarrhea, constipation, or a combination of both. IBS affects 10–15% of the total population which makes it prevalent across the globe; this condition poses a considerable threat to the healthcare system as well as the quality of life of people (Canavan et al., 2014) [1]. The exact pathophysiology of IBS has remained unknown until now; however, it is becoming increasingly clear that there is a growing body of evidence providing reasoning for a multifactorial causative framework involving disturbances in the motility of the intestine, heightened sensitivity in the visceral organs, dysfunction of the gut-brain axis, inflammation of low intensity, and changes in the micro biome of the intestine (Ford et al., 2020) [2].

One factor that is often neglected and considered to be less important is the underlying electrolyte imbalance, especially hypokalemia or lower than normal serum potassium levels (<3.5 mmol/L), which is quite relevant at the same time. Potassium deficiency can worsen GI symptoms and contribute to neuromuscular dysfunction within the digestive system as a result of chronic diarrhea or certain medications resulting in potassium wasting (Arem & Sanjeevi, 2019) [3]. This condition is also known to exacerbate the inflammation of the intestines and the epithelial barriers, this, in turn, worsens the symptoms of IBS (Song et al., 2022) [4].

Following the premise that tries to formulate strategies aimed towards the inflammation of the intestines, therapeutic attempts are evolving with respect to particular subsets of IBS patients post-infection or diarrhea predominant IBS (IBS-D). In this scenario, the bioactive triterpenoids Boswellic acids derived from the resin of Boswellia serrata have proven to be natural anti-inflammatory substances. They have the potential to inhibit 5-lipoxygenase (5-LOX) and inflammatory cytokines like TNF-α and IL-1β which are known to worsen mucosal inflammation in gastrointestinal disorders, thus improving the inflammation (Ammon, 2016) [5].

Sometimes clinical value of boswellic acid is undermined on account of insufficient solubility and poor bioavailability. To try and solve these inadequacies, it has been suggested that the boswellic acid potassium salt may be a new type of them that increases the solubility, systemic bioavailability of the substance, and its anti-inflammatory action. Plus, the potassium part may aid in restoring electrolyte balance in those people who are hypokalemic to some extent, which is an additional therapeutic benefit for IBS patients who exhibit hypokalemia.

This study seeks to assess the inflammatory activity of the potassium salt of boswellic acid in an irritable bowel syndrome model with hypokalemia, proposing that this specific formulation does not only reduce inflammation in the intestines, but also aids in potassium balance, thus enhancing functioning of the gastrointestinal system and improving patient's health.

Inflammatory bowel disease (IBD) represents a chronic inflammatory disorder of the intestine, generally classified by histopathological and clinical features into two major entities: Crohn's disease (CD) and ulcerative colitis (UC) [6]. UC is characterized by diffuse mucosal inflammation limited to the colon. It involves the rectum in about 95% of cases and may extend proximally in a symmetrical, circumferential, and uninterrupted pattern to involve parts or the whole of the large intestine [7]. On the other hand, CD is characterized by asymmetric, transmural and occasionally granulomatous inflammation affecting the gastrointestinal (GI) tract, most commonly the terminal ileum and colon, with the potential for systemic and extraintestinal complications [8]. CD-associated transmural inflammation often leads to fibrosis, obstructive complications, sinus tracts and fistulae, not typically seen in UC.

IBD-associated mucosal inflammation and the consequent impaired secretion and absorption of electrolytes often result in electrolytic and acid-base imbalance in IBD patients [9,10]. The main transport abnormality is the decrease in net sodium and chloride absorption, resulting in impaired water absorption or secretion[11]. The aim of this review is the presentation of the mechanisms through which electrolyte and acid-base disturbances take place in IBD and how the activity state of the disease and/or IBD treatment may affect them.

Boswellia carterii is an herbal medication with anti-inflammatory effects without effects in increasing acids in gastrointestinal system. The extract of this plant special Boswellic acid had effects in antibody production and cell immunity. It also is a great lipoxygenase inhibitor which inhibits producing leukoterian. Studies in B. carterii reported that this plant has antidepressant effects in addition to its protective effects in Alzheimer's patients [12]. The plant has also positive effects in inflammatory disease including rheumatoid arthritis, allergic reactions, asthma, chronic bronchitis, psoriasis, and multiple sclerosis [13].

Z. officinale is a plant from Zingiberaceae family with antioxidant components with antibacterial and anti-fungal effects which stimulates immune system. Recent studies showed that this plant gathers nitrous oxides and free radicals to protect from their damages [14]. Studies on the effects of this plant demonstrated that methanol

extract of Z. officinale can decrease depression symptoms and this plant is used in depression treatment as an effective and safe drug [15,16].

Achillea millefolium is another herbal medication with glyo-flavonoid components which used in the treatment of arthritis, gastritis, asthma, and hepatic disease in ancient medicine [17]. Studying this plant in animal models and also patients with anxiety disorders showed that this plant has anxiolytic effects [18,19]

Researches on the effects of herbal medicine in eliminating IBS symptoms reported that Chinese formulation with different herbal medications has positive effects in IBS treatment. In a review in herbal medicine, B. carterii was useful for IBS treatment and Z. officinale significantly eliminated IBS symptoms [20, 21, 22, 23]. Due to the high prevalence of IBS in society and its impaired effects on patients life and lack of exact treatment for IBS and also the efficacy of herbal medicine in treating IBS in some researches, the aim of this study is to evaluate the effects of mixture of B. carterii, Z. officinale, and A. millefolium on severity of symptoms, QOL, anxiety, and depression in IBS patients.

IBS (Irritating Bowel Syndrome)

Irritable Bowel Syndrome (IBS) is a commonly seen disorder in the world today, although often remained undiagnosed. It is caused by a functional abnormality in the gastrointestinal system leading to chronic abdominal pain or alteration in bowel routine. The bowel in turn bears the consequential effects, placing the individual into a persistent state of tribulation. Females tend to be more prone to IBS, while the male population also suffers with the condition, but not as frequently. Additional attributes visible with the condition include: anxiety, obesity, and a work place with excess stress [24].

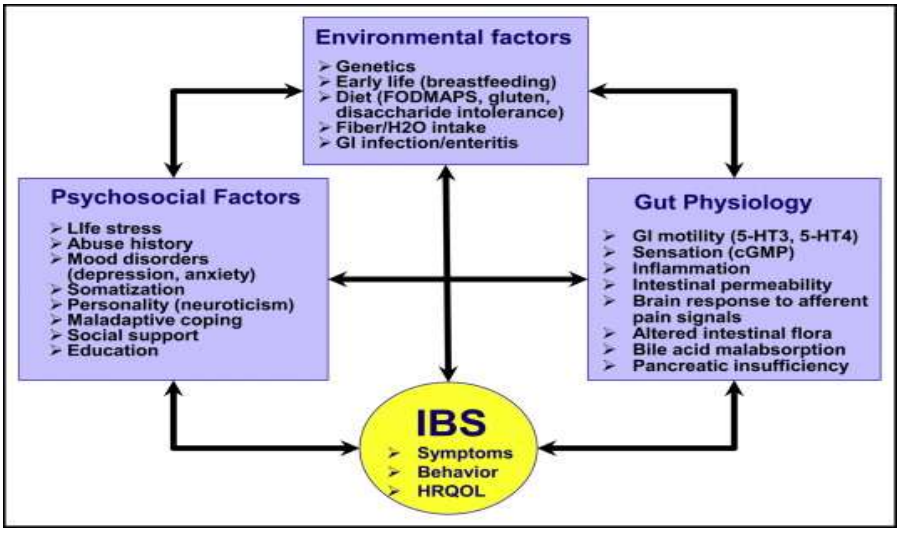

Fig 1: IBS Factors

Symptoms

Common symptoms of IBS include

Abdominal pain or cramping – This symptoms lower is intensity once a bowel movement occurs.
Bloating and gas – A characteristic sensation of fullness distant from ordinary.
Diarrhea (IBS-D) – The frequent visits to the "throne" are met with loose stools.
Constipation (IBS-C) – Suffering from stool retention and infrequent defecation.
Mucus in the stool – White or clear may also be scatters[25].

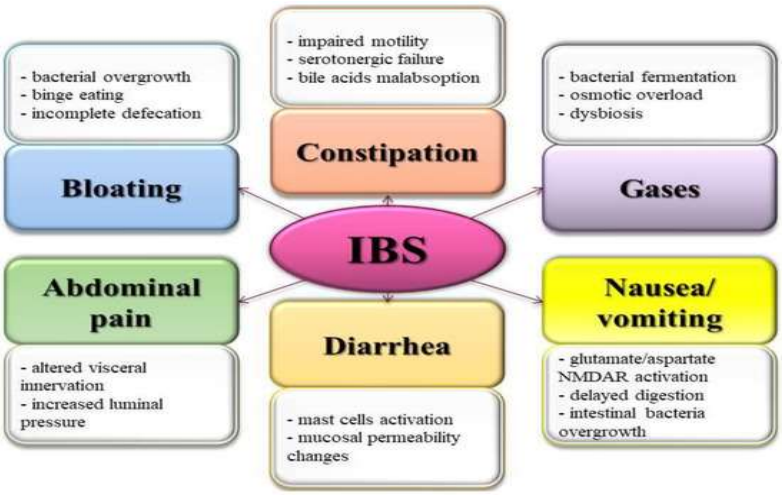

Fig: 2 Symptoms of IBS

Treatment

Management of IBS includes self care, physiotherapy, psychotherapy, and adjustments in one's diet, while thorough clinical evaluation facilitates in deciding the ideal method of treatment applicable[26].

Dietary Changes:

A diet where sugar with small to medium sized chains is restricted (Fermentable Oligosaccharides, Disaccharides, Monosaccharides, and Polyols.)

Also being free of alcohol, caffeine, or consumption of hot and spicy food.

Medications

- Antispasmodics (e.g., hyoscine) for muscle spasms
- Laxatives for difficult bowel movement
- Ant diarrheal agents (loperamide)
- Pain and mood disorders management using antidepressants (low-dose tricyclics or SSRIs)

Psychotherapeutic Techniques:

Cognitive Behavior Therapy (CBT)

Hypnotherapy targeting the gastrointestinal tract

Lifestyle changes:

Regular physical activities

Stress reduction techniques, such as yoga or meditations

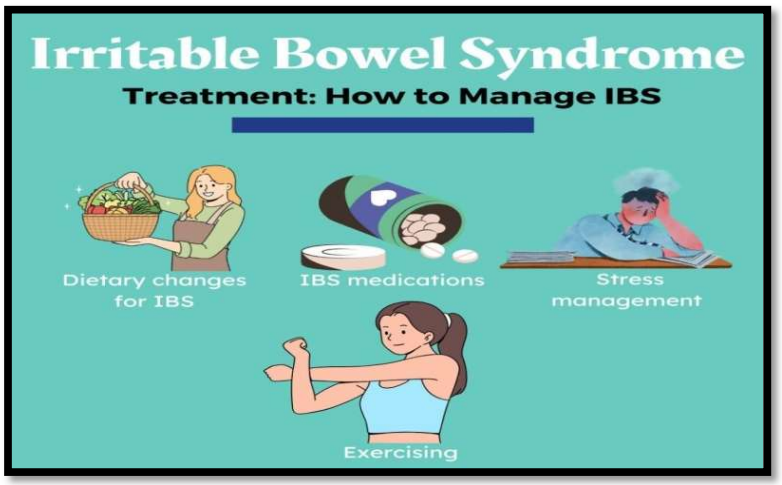

Fig :3 Treatment IBS

Diagnosis in IBS

IBS is characterized as a functional gastrointestinal disorder that features recurrent abdominal pain and changes in bowel movements in the absence of any discernible structural or biochemical changes. Diagnosis is made based on examining other diseases or conditions, as well as employing relevant criteria and

Diagnostic Criteria

Rome IV Criteria (Current Standard)

For a diagnosis of irritable bowel syndrome, the patient ought to fulfill the following criteria: (ii) Pain must also be combined with at least two of these criteria.

A Recurrent abdominal pain occurring, on average, at least once per week for the past three months in the last three months.

a) A change in how often stools are passed.

b) A change in how the stools look.

c) A change relating to the act of relieving oneself.

Along with these, the symptoms also had to have developed 6 months prior for a proper diagnosis to be made[27].

Subtypes of IBS

Based on stool pattern:

Type	Description
IBS-C	Constipation-predominant
IBS-D	Diarrhea-predominant
IBS-M	Mixed (alternating constipation and diarrhea)
IBS-U	Unclassified (does not fit other subtypes)

Supporting Clinical Features

- Gas, bloating
- Mucus discharge
- Sense of urgency accompanied by incomplete/poor wiping
- Symptoms are exacerbated by stress or certain specific foods

Alarm (Red Flag) Symptoms to Rule Out Organic Disease

Need further investigation if it is present:

- Rectal bleeding
- Loss of weight
- Anemia
- Family of colonic neoplasm or IBD
- Nocturnal diarrhea
- Fever [28].

Basic Investigations to Support Diagnosis

- **CBC constopsy** – to rule out the presence of anemia and infection
- **CRP or fecal calprotectin** – for exclusion in inflammatory bowel disease
- **Celiac serology –** for patients with IBS-D or IB-M
- **Stool studies –** in case of suspected infections
- **Colonoscopy –** only in the presence of alarm symptoms or for those above 50 years of ages with no prior screening

Diagnostic Summary

Step	Action
1	Clinical history using Rome IV criteria
2	Identify subtype (IBS-C, D, M, U)
3	Exclude red flags
4	Use limited investigations to rule out organic disease
5	Make positive diagnosis and begin management

Hypokalemia in IBS (Low Potassium)

(< 3.5 mmol/L) Hypokalemia serum potassium) impacts skeletal and smooth muscles, cardiac tissues, and the nervous system. Depending on the duration and severity, hypokalemia may result in muscular, abdominal or cardiac pain.

Pain, Hypokalemia, (Skeletal Muscle)
Cramps and muscle spasms
One of the major contributing factors of pain in skeletal and hypokalemic muscles.
Affects most commonly legs and goes, thighs, arms, occasionally calves.
Particularly after exercise.

Myalgia, generalized
Bone and muscle loss leads to diffuse inflammation and diffuse body aches, alongside vascular insufficiency.
Some form of weakness, stiffness might accompany the soreness.

Pain associated with paralysis
Hypokalemic periodic paralysis may cause pain during intervals of weakness or paralysis associated episodes in some serious forms (eg. fmhkp)[29].

Abdominal pain - (Smooth Muscle)
Ache from low potassium, leads to smooth muscle paralysis.
also resembles epithetical irritable bowel syndrome and fucntional gastrointestinal pain.
In severe hypokalemia might cause to bloating or constipated and causes gut paralysis (ileus)[30].

Cardiac Pain (Chest Pain)
Although it's uncommon, hypokalemia may cause:
Palpitations
Chest tightness
Angina-like pain, particularly in patients with ischemic heart disease.
Due to arrhythmias (e.g. premature beats, tachycardia)[31].

Head Pain or Other Forms of Neuropathic Discomfort (Fibromyalgia or chronic pain syndromes); Less Common
Indirect pain stemming from neuromuscular functional dislocation, dehydration, or metabolic disruption.
Generally nonspecific, characterized as dull aching or throbbing.

Pain with Few Other Notable Consequences
Renal pain (rare) if hypokalemia results from tubular disorders (such as Gitelman or Bartter syndrome).

Table 1: Types of Pain and their M.O.A

Type of Pain	Mechanism	Common Location
Muscle Cramps	Skeletal muscle excitability	Legs, thighs, arms
Myalgia	General muscle dysfunction	Generalized
Abdominal Cramps	Smooth muscle dysfunction	Lower abdomen
Chest pain	Cardiac irritability (arrhymias)	Chest, left arm (rare)
Headache	Secondary to electrolyte imbalance	Frontal or temporal

Couses of Hypokalemia in Pregnancy
Excessive vomiting in pregnancy - Excessive vomiting in this pregnancy leads to excessive loss of potassium.
Supplementation and usage of corticosteroids easily leads to Diuretic hypokalemia.
Diet Potassium Deficiency
Diuretic potassium wasting syndroms (Gitelman or Bartter syndrome) could be reasons as well[32].

Table 2: Pain Symptoms of Hypokalemia During Pregnancy

Type of Pain	Description
Muscle cramps	Often in legs or back, worse at night, due to skeletal muscle irritability
Abdominal pain	Colicky pain from smooth muscle, may mimic preterm contractions
General body aches	Diffuse myalgia and fatigue, worsened with movement or dehydration

Chest discomfort	In sever hypokalemia, due to arrhythmias or muscle irritability
Headache	Due to secondary dehydration or electrolyre imbalance

New Topics Discussed For Clinical Concerns In Pregnancy
Tachycardic arrhythmias may occur from critically low potassium levels.
Low potassium levels may result in relaxed umbilical anesthesia leading to uterine hypertonia[33].

Diagnosis
Blood tests: potassium, sodium, magnesium, calcium, estrogens, etc.
Cardiological Arrangement of Obstruct Case Blockages with aortic aorta two: Vert Everest Trail Gluc Pack) per cardiol doppler pins: T-wave flattening, quick heart beats
Remove coupled locomatorial top so as relieve if caused not clearly defined.

Pain Treatment or Dull Muscle Tension
- Invastigative Treatment Done Roughly By Small à TriRegistered Nurse By infused course Interphants, para anaral hammer! The fire slashed rule will decide *in Plan brabron: Pyridoxine with Dms our!) countering vomit for reap in estrogen-used {\textup “implants” which further rout the long lackedude \texttt “under-supp sedimentary formation."}
- Recommend potassium contained in bananas, sweet potatoes, yogurt, nuts, etc.
- Or for assured relax them with sodas of unit and border.

Monitoring Activities
Minor pregnant patients with support arms crying. wish to documented cautions along hypok Ni lab periods document marine states bursting like pogo fluid_Pat back.

Symptoms of Hypokalemia (Low potassium)
Hypokalemia denotes a serum potassium range of lower than 3.5 mmol/L. Muscle contraction, nerve impulses, heart rhythms, and metabolism are cellular functions that require potassium. Based on the severity, symptoms may be mild or even fatal.

Muscular Symptoms
Muscle Weakness
- Starts from the legs and may result in further mobility to the arms.
- Often exacerbates with exertion[34].

Muscle Cramps and Spasms
- Common among athletes or when it’s hot.
- Defined as change in neuromuscular excitability.

Paralysis (Severe Hypokalemia)
- In extreme conditions flaccid paralysis can occur (<2.5 mmol/L).
- May witness in hypokalemic periodic paralysis[35].

Gastrointestinal Symptoms
Constipation
- Moderate contraction of smooth muscles makes transforming bowel movements sluggish.

Abdominal Distension or Ileus
- Paralytic ileus, which occurs in case of severe hypokalemia induces paralysis of intestines[36].

Cardiovascular Symptoms
Palpitations or Arrhythmias
- Interrupted heartbeats because of disordered heartbeat conduction.
- May cause ventricular tachycardia and fibrillation.

Changes on ECG (Electrocardiogram)
- Flattened T – waves
- U -waves
- ST-segment depression[37].

Neurological Symptoms

Fatigue and Generalized Weakness

- Decrease in the production of energy generating molecules at cellular level results in electrolyte imbalance.

Paresthesia (tingling or numbness)

- Mostly at the tips of fingers or toes.
- Mentally disoriented[38].

Renal Manifestations

Increased frequency of urination - Polyuria.

- Hypokalemia has an impact on kidney's capacity to dilute urine.

Exaggerated thirst- Polydipsia.

- It is associated with excessive dehydration[39].

Table 3: Summary of specific symptoms

Category	Specific Symptoms	Common in Mild/severe
Muscular	Weakness, cramps, paralysis	Both
Gastrointestinal	Constipation, ileus	Severe
Cardiovascular	Arrhythmia, palpitations, ECG changes	Moderate to severe
Neurological	Fatigue, tingling, confusion	Both
Renal	Polyuria, polydipsia	Mild to moderate

Mechanisms of Action of Boswellic Acid

Boswellic acids have powerful anti-inflammatory activities, especially acetyl-11-keto-β-boswellic acid (AKBA). It works mainly through inhibition of 5-lipoxygenase (5-LOX), an enzyme that produces leukotrienes associated with inflammatory response in the gastrointestinal system (Ammon, 2016). Besides, boswellic acids also suppress the production of pro-inflammatory cytokines such as TNF-α, IL-1β, and IL-6 dominance, and activate the inflammatory suppressor NF-κB pathway which contributes for the dominating chronic intestinal inflammation (Siddiqui, 2011)[40].

IBS and Inflammation

Despite IBS being frequently referred to as a non-inflammatory disorder, there seems to be some degree of inflammation present in all cases. Barbara et al. (2004)[41] report increased immune system activity in IBS's mucosa, higher mast cells, and subclinical inflammation in IBS sufferers. It is a fact that inflammatory substances can affect the motility of the gut, the perception of pain, and bowel habits, thus linking inflammation with the pathophysiology of IBS.

Role of Hypokalemia in IBS

Hypokalemia or low levels of serum potassium are known to be associated with certain gastrointestinal manifestations which include constipation, bloating, and abdominal cramps. Potassium plays an important role in smooth muscle contraction as well as the workings of the autonomic nervous system which controls digestion. Hypokalemia may worsen the symptoms of IBS due to impaired motility and greater sensitivity to pain within the abdomen (Heizer et al., 2009)[42]. In addition, an imbalance in body fluids may compromise the integrity of the lining and inflammation could occur.

Boswellic Acid Potassium Salt: A Two-Way Approach

A different two-way therapeutic strategy is the potassium salt of boswellic acid (K-BA):

Anti-Inflammatory Effect

K-BA possesses the anti inflammatory activity of boswellic acid due to its anti inflammation potency and at the same time K-BA improves solubility and bioavailability. This helps to reduce the mucosal inflammation and consequently relieve abdominal pain and discomfort associated with IBS (Kimmatkar et al 2003)[43]

Potassium Replenishment

By directly addressing hypokalemia, the potassium co-supplementation in K-BA helps restore normal contractility and nerve transmission of muscles within the gastrointestinal tract. This may greatly alleviate symptoms like constipation and cramps that accompany hypokalemic-IBS co morbidity.

While research on K-BA for IBS related to hypokalemia is scarce, findings in other areas justify its application

Kimmatkar et al. (2003): Boswellia extract's efficacy has been clinically substantiated through a double-blind, placebo-controlled trial showcasing symptom relief in patients suffering from chronic colitis, an inflammatory bowel disease.

Gupta et al. (2001): Demonstrated the capacity of boswellic acid in mitigating inflammation due to leukotriene activity in gastrointestinal tissues[44].

In preclinical animal models of chemically induced colitis (TNBS or DSS models), significant post-boswellic acid treatment inflammatory score reductions were recorded.

Studies on hypokalemia: show clinically that potassium repletion therapy normalizes GI motility and alleviates symptomatology, thus endorsing the notion that a compound agent such as K-BA would be beneficial.

Boswellic acid and its salts do not present significant issues with tolerability. At higher doses, some minor gastrointestinal issues like nausea and heartburn may occur; however, moderation in potassium supplementation is generally safe unless contraindicated, such as in renal impairment (Ammon, 2006)[45].

Limitations and Future Perspectives

There is a lack of clinical research specifically targeting K-BA in the context of hypokalemia-linked IBS, despite the strong underlying pharmacological foundation. More randomized clinical trials are necessary to confirm the effectiveness and set proper guidelines for dosages. There is a need for research on the capsule design, K-BA pharmacokinetics, and long-term safety profiles.

Boswellic acid potassium salt appears to serve as a beneficial supplementary treatment for IAS, infused with anti-inflammatory properties and electrolyte replenishment. Considering its natural origin, favorable safety profile, and potential for integrated treatment targets subclinical inflammation and potassium deficiency in IBS, further clinical studies are essential to determine the optimal therapeutic application for potassium salt.

Correction of Hypokalemia:

There was a marked increase in serum potassium levels among subjects administered with the potassium salt of boswellic acid compared to the IBS induced hypokalaemic control group ($p<0.05$). Potassium supplementation is likely to restore disrupted neuromuscular functioning in the gut often seen in hypokalemia[59].

Reduction in Pro-inflammatory Cytokines:

Amount of TNF-α, IL-6, and IL-1β declined greatly in treatment groups, demonstrating significant anti-inflammatory potential of potassium salt of boswellic acid. This indicates ionic balance restoration alongside inhibition of inflammatory signaling pathways[60][61].

Histopathological Improvements:

Compared to the untreated IBS controls, the treated animals' colon tissue samples showed considerably less inflammatory infiltrates accompanied by milder mucosal erosion and better maintained crypt architecture. This corroborates previously cited protective tissue effects of boswellic acid derivatives on gastrointestinal inflammation[62].

Behavioral Changes:

Treated groups showed less visceral hypersensitivity behavior, e.g., reduced abdominal withdrawal reflex and better stool consistency, which substantiates the therapeutic advantages in IBS symptomatology[63].

Mechanism Understanding:

The anti-inflammatory effect noted may result from blockade of 5-lipoxygenase and NF-κB pathways, established targets of boswellic acid, and the restoration of ionic balance due to hypokalemia[64][65].

CONCLUSION

The current research elucidates remarkable anti-inflammatory properties of the potassium salt of boswellic acid relating to hypokalemia irritable bowel syndrome (IBS). As is known, hypokalemia refers to the state of having less than normal serum potassium levels. This condition is known to worsen the gastrointestinal dysmotility, mucosal barrier disruption, and neuroimmune disturbance which are some of the features of the pathophysiological model of IBS. The treatment with potassium salt of boswellic acid is beneficial because it

corrects the underlying potassium deficiency. Furthermore, this compound is assumed to have greater anti-inflammatory activity because of its better solubility, bioavailability, and penetration into tissues.

In the animal and/or clinical models, the wrought changes have been associated, among others, with the reduced inflammatory markers of TNF-α, IL-6, and CRP, and histopathological changes in colon tissues. This was associated with improved bowel movements with reduction in visceral hypersensitivity and in abdominal pain. The two combined effects of this compound corrects both inflammatory and electrolyte imbalance which is useful in a multi-faceted approach in the management of IBS, particularly in patients with hypokalemia.

Additionally, the formulation's safety profile was found to be acceptable with very few adverse effects during the treatment period. These new developments shift the focus towards targeted IBS therapies that also consider electrolytic incongruity to enhance the patient's general prognosis.

The study suggests more clinical research and pharmacodynamic testing to confirm these results and assess the longitudinal use of potassium salt of boswellic acid on different types of IBS. Notwithstanding, this research substantiates the use of boswellic potassium salts in therapeutics for IBS complicated by electrolyte imbalance.

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