



E-ISSN: 2709-9385

P-ISSN: 2709-9377

JCRFS 2023; 4(2): 52-56

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[www.foodresearchjournal.com](http://www.foodresearchjournal.com)

Received: 12-07-2023

Accepted: 23-08-2023

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## Effects of nutraceutical on gastrointestinal tract disorders

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### Abstract

The potential therapeutic function of nutraceuticals in the treatment of gastrointestinal tract disorders has garnered increasing attention in the area of gastroenterology. The purpose of this article is to provide readers an overview of the complex field of nutritional supplements in relation to gastrointestinal disorders. Through a review of the scientific literature written by different authors, we are able to identify the changing viewpoints and contributions that support the investigation of nutritional supplementation as supplementary or alternative therapies to conventional medical treatments for gastrointestinal illnesses. Nutraceutical interventions offer a complementary approach to conventional treatments, providing patients and healthcare practitioners with additional tools for managing and improving gastrointestinal health.

**Keywords:** Nutraceuticals, health benefits, pharmaceuticals, inflammatory bowel diseases, gastrointestinal tract problems

### 1. Introduction

The potential therapeutic function of nutraceuticals in the treatment of gastrointestinal tract disorders has garnered increasing attention in the area of gastroenterology. A combination of the words "nutrition" and "pharmaceuticals," "nutraceuticals" refer to a wide range of bioactive substances that are either dietary supplements or produced from food sources (Tewari *et al.*, 2020) [31]. These substances offer physiological advantages above and above their fundamental nutritional value, and they have drawn interest because they may be able to prevent and treat a number of gastrointestinal illnesses (Calder, 2013) [7].

A variety of disorders may jeopardize the integrity and function of the gastrointestinal tract, a complex system that is in charge of digesting and nutritional absorption. Peptic ulcers, irritable bowel syndrome (IBS), inflammatory bowel diseases (IBD), and other functional problems are among the digestive illnesses that provide serious difficulties for patients and medical professionals. The investigation of alternative therapeutic possibilities, such as nutraceuticals, is an appealing area since conventional therapies for these disorders sometimes include medicines that have possible negative effects.

The influence of nutraceuticals on gastrointestinal health has been the subject of increased study in recent years, with particular attention paid to their anti-inflammatory, antibacterial, and mucoprotective qualities (De-Souza *et al.*, 2019) [11]. This investigation fits in with the larger idea of precision nutrition, which customizes dietary therapies to meet the requirements and circumstances of each person. The potential of nutraceuticals to supplement conventional medical treatments is becoming more and more apparent as our knowledge of the complex interactions between nutrition and gastrointestinal health increases.

The purpose of this introduction is to provide readers an overview of the complex field of nutraceuticals in relation to gastrointestinal disorders. Through a review of the scientific literature written by different authors, we are able to identify the changing viewpoints and contributions that support the investigation of nutraceuticals as alternatives or adjuncts in the treatment of gastrointestinal illnesses.

### Alleviation of Gastrointestinal Inflammation

Bioactive substances found in a wide range of dietary sources are known as nutraceuticals, and they have shown promise as treatments for gastrointestinal tract problems, especially when it comes to reducing inflammation. Turmeric contains a polyphenolic molecule called

curcumin, which has been shown to have anti-inflammatory qualities via modulating many signaling pathways connected to inflammation (Aggarwal *et al.*, 2013) <sup>[1]</sup>. Studies looking at curcumin's effect on diseases including gastritis and inflammatory bowel disease (IBD) have shown how effective it is at lowering inflammation (Bengmark, 2006; Bundy *et al.*, 2020) <sup>[3, 6]</sup>.

Furthermore, fish oil, which is high in omega-3 fatty acids, has anti-inflammatory properties that may help people with IBD by lowering the generation of pro-inflammatory mediators (Calder, 2013) <sup>[7]</sup>. Higher dietary consumption of omega-3 fatty acids is linked to a lower chance of acquiring Crohn's disease, according to research by Ananthakrishnan *et al.* (Ananthakrishnan *et al.*, 2014) <sup>[2]</sup>, highlighting the possible preventative effect of these chemicals.

Nutraceuticals have the ability to reduce inflammation since they include a range of bioactive components that may be found in a variety of dietary sources. For instance, flavonoids - which are found in fruits and vegetables - have anti-inflammatory qualities that have been linked to a lower risk of gastrointestinal diseases (Kim *et al.*, 2017) <sup>[19]</sup>. By influencing inflammatory pathways, these substances may lessen the severity of diseases including colitis and gastritis. The work of Haenen *et al.* (Haenen *et al.*, 2006) <sup>[13]</sup> highlights the function of flavonoids in regulating inflammation and oxidative stress, which further bolsters the anti-inflammatory properties of flavonoids.

Additionally, nutraceuticals influence cytokine and chemokine regulation in relation to gastrointestinal inflammation. One prospective treatment option for gastrointestinal tract inflammation is quercetin, a flavonoid included in foods like onions and apples that has been shown to decrease pro-inflammatory cytokines (Boots *et al.*, 2008) <sup>[5]</sup>. According to a research by Kuo *et al.* (Kuo *et al.*, 2015) <sup>[21]</sup>, quercetin may reduce intestinal inflammation in colitis experimental models, indicating that it may have therapeutic value.

Nutraceuticals, which include substances like curcumin, omega-3 fatty acids, and flavonoids, have a variety of anti-inflammatory properties that demonstrate their potential therapeutic use in treating gastrointestinal problems associated with inflammation.

### Modulation of Gut Microbiota

Nutraceuticals play a pivotal role in the modulation of the gut microbiota, influencing the composition and activity of the microbial communities residing in the gastrointestinal tract. Probiotics, defined as live microorganisms with potential health benefits, contribute to the maintenance of a balanced gut microbiota (Hill *et al.*, 2014) <sup>[15]</sup>. *Lactobacillus* and *Bifidobacterium* species, commonly found in probiotic supplements and fermented foods, are known for their ability to enhance gut microbial diversity and promote a favorable gut environment (Hill *et al.*, 2018) <sup>[16]</sup>.

Prebiotics, non-digestible compounds that selectively stimulate the growth and activity of beneficial bacteria, also contribute to gut microbiota modulation. Fructooligosaccharides (FOS) and inulin, found in various fruits, vegetables, and whole grains, serve as prebiotics that selectively nourish beneficial bacteria like *Bifidobacterium* (Gibson *et al.*, 2017) <sup>[12]</sup>. The research by Roberfroid (Roberfroid, 2007) <sup>[27]</sup> emphasizes the significance of prebiotics in fostering the growth of beneficial bacteria and improving gut microbial composition.

Furthermore, the interaction between probiotics and prebiotics, known as synbiotics, synergistically enhances their beneficial effects on the gut microbiota. The combination of probiotics and prebiotics promotes the survival and activity of probiotic strains, ensuring their positive impact on the gut microbial ecosystem (Swanson *et al.*, 2020) <sup>[30]</sup>. This symbiotic relationship contributes to the overall balance and diversity of the gut microbiota, influencing various aspects of gastrointestinal health.

In addition to probiotics and prebiotics, certain nutraceuticals exhibit antimicrobial properties that can selectively target harmful bacteria while sparing beneficial ones. Polyphenols, abundant in fruits, vegetables, and tea, have been studied for their antimicrobial effects and their potential to shape the gut microbiota (Cardona *et al.*, 2013) <sup>[8]</sup>. The study by Mosele *et al.* (Mosele *et al.*, 2017) <sup>[24]</sup> explores how polyphenols may act as modulators of the gut microbiota, influencing its diversity and supporting the growth of beneficial bacterial species.

In summary, the modulation of gut microbiota by nutraceuticals, including probiotics, prebiotics, synbiotics, and polyphenols, underscores their role in promoting a balanced and healthy gastrointestinal microbial ecosystem.

### Protection of Gastrointestinal Mucosa

The gastrointestinal mucosa, which is the vital lining of the digestive system, is greatly protected and maintained by nutraceuticals. De-Souza *et al.* (De-Souza *et al.*, 2019) <sup>[11]</sup> have shown that compounds such as glutamine, an amino acid included in a variety of meals and supplements, are essential for maintaining the integrity of the gut lining and fostering mucosal repair. The significance of glutamine in reducing intestinal mucosal damage and enhancing the general well-being of the gastrointestinal system is highlighted by research conducted by Déchelotte *et al.* (Déchelotte *et al.*, 2013) <sup>[10]</sup>.

Furthermore, additional bioactive substances like the polyphenols in berries and green tea are also protected by nutraceuticals. By lowering oxidative stress and inflammation, polyphenols' anti-inflammatory and antioxidant qualities help to maintain the mucosal barrier (Pastoriza *et al.*, 2016) <sup>[25]</sup>. The Wang *et al.* (Wang *et al.*, 2019) <sup>[33]</sup> research shows how polyphenols may improve mucosal defense systems and lessen harm to the gastrointestinal epithelium.

Furthermore, nutraceuticals' mucoprotective qualities include the regulation of mucin synthesis. Glycoproteins called mucins provide a barrier on the mucosal surface to stop damage and support a healthy gut environment. Some nutraceuticals promote the formation of mucin and aid in the preservation of mucosal integrity. One such nutraceutical is butyrate, a short-chain fatty acid obtained from dietary fiber (Jakobsson *et al.*, 2015) <sup>[17]</sup>. The processes by which butyrate promotes mucin formation and its consequences for gastrointestinal health are explored in the study conducted by Lewis *et al.* (Lewis *et al.*, 2015) <sup>[22]</sup>.

Moreover, it is clear that nutraceuticals have the ability to both prevent and treat stomach ulcers. The gastroprotective properties of substances like zinc-carnosine, a chelate of zinc and carnosine, have been researched. According to Suzuki *et al.* (Suzuki *et al.*, 2017) <sup>[29]</sup>, zinc-carnosine facilitates the healing of stomach ulcers, improves mucosal blood flow, and encourages the restoration of injured mucosa. In their 2019 research, Urita *et al.* explore the

effectiveness of zinc-carnosine in peptic ulcer patients' healing processes and gastrointestinal mucosal protection (Urita *et al.*, 2019) [32].

Nutraceuticals - which include zinc-carnosine, glutamine, polyphenols, and butyrate - basically support the repair and preservation of the gastrointestinal mucosa, indicating their potential use as therapeutics in a range of gastrointestinal conditions.

### Effects of nutraceuticals on gastrointestinal tract diseases

The term "gastrointestinal" (GI) tract diseases refer to a group of illnesses that impact the composition and operation of the digestive system. These illnesses include peptic ulcers, functional abnormalities, and inflammatory bowel diseases (IBD) and irritable bowel syndrome (IBS). Bioactive substances called nutraceuticals that may be obtained as supplements or from food have come to light as possible adjuncts in the treatment of these conditions because of their variety of benefits for GI health.

#### a) Anti-Inflammatory Properties

In the setting of GI disorders, nutraceuticals including omega-3 polyunsaturated fatty acids (PUFAs) have been studied for their potential anti-inflammatory properties (Calder, 2013) [7]. Fish oil contains omega-3 polyunsaturated fatty acids (PUFAs), which have the ability to regulate inflammatory processes and may help relieve symptoms of illnesses such as ulcerative colitis and Crohn's disease (Ananthakrishnan *et al.*, 2014) [2].

#### b) Gut Microbiota Modulation

One kind of nutraceutical that helps with this modulation is probiotics, which are live beneficial bacteria. Commonly found in probiotic supplements, *Lactobacillus* and *Bifidobacterium* strains contribute to microbial balance and may be beneficial for illnesses such as IBS (Hill *et al.*, 2018; Quigley, 2017) [16, 26].

#### c) Mucoprotective Effects

Glutamate is one of the nutraceuticals that has been shown to have mucoprotective properties, supporting the integrity of the gastrointestinal mucosa (Déchelotte *et al.*, 2013) [10]. These substances could help treat disorders like peptic ulcers by shielding mucous membranes from harm.

#### d) Antioxidant and Cytoprotective Actions

Polyphenols, which are found in large quantities in fruits, vegetables, and tea, have cytoprotective and antioxidant qualities that help prevent oxidative stress in the gastrointestinal system (Pastoriza *et al.*, 2016) [25]. Polyphenols support the gastrointestinal epithelium's cytoprotective mechanisms by lowering oxidative damage.

#### e) Symptom Alleviation in Functional Disorders

According to Hawrelak and Myers (Hawrelak & Myers, 2010) [14] and Khanna *et al.* (Khanna *et al.*, 2014) [18], several herbal extracts and peppermint oil have shown potential in reducing the symptoms of functional gastrointestinal diseases, including IBS. These organic substances could provide alleviation from discomfort and agony in the abdomen.

#### f) Fiber Supplementation for Bowel Regularity

According to Bijkerk *et al.* (Bijkerk *et al.*, 2009) [4], soluble

fiber supplements and psyllium husk are two examples of nutraceuticals high in dietary fiber that support bowel regularity and may help those with IBS that is constipation-predominant. Fiber pills provide a natural way to manage symptoms by bulking up stool and encouraging easy bowel movements.

#### g) Management of Gastroesophageal Reflux Disease (GERD)

A nutraceutical called deglycyrrhizinated licorice (DGL), which is made from licorice root that has had the glycyrrhizin extracted, has shown promise in treating GERD symptoms. DGL offers a supplemental treatment option for those with acid reflux by potentially reducing esophageal irritation and promoting mucosal tissue recovery (Lang *et al.*, 2019) [21].

#### h) Role of Curcumin in Inflammatory Bowel Diseases

The key ingredient in turmeric, curcumin, has anti-inflammatory qualities that may help treat inflammatory bowel conditions (Lang *et al.*, 2019) [21]. Curcumin may be able to lessen intestinal inflammation, which might make it a useful supplement to standard therapies for diseases including Crohn's disease and ulcerative colitis.

#### i) Prevention of *Helicobacter pylori*-Associated Gastric Disorders

The potential of nutraceuticals, such as cranberry extracts and mastic gum, to prevent *Helicobacter pylori* infection and related stomach diseases has been investigated (Cellini *et al.*, 2014; Shmueli *et al.*, 2012) [9, 28]. These organic substances could have antibacterial qualities that help treat problems linked to *H. pylori*.

#### j) Gastroprotective Effects of Aloe Vera

Well-known for its healing and anti-inflammatory qualities, aloe vera has also been investigated for its potential gastroprotective benefits in diseases such as peptic ulcers (Yusuf *et al.*, 2014) [34]. Aloe vera gel has promise in the nutraceutical arsenal as it may preserve mucosa and hasten the healing of stomach ulcers.

As research in this field progresses, a deeper understanding of the specific effects of nutraceuticals on GI tract diseases continues to evolve. The exploration of nutraceutical interventions offers a complementary approach to conventional treatments, providing patients and healthcare practitioners with additional tools for managing and improving gastrointestinal health.

Recent research has shown the anti-inflammatory characteristics of omega-3 polyunsaturated fatty acids (PUFAs), indicating their potential to regulate inflammatory processes linked to diseases such as ulcerative colitis and Crohn's disease (Ananthakrishnan *et al.*, 2014; Calder, 2013) [2, 7]. Simultaneously, one important approach to treating microbial imbalances in illnesses such as IBS is the manipulation of the gut microbiota with probiotics, such as strains of *Lactobacillus* and *Bifidobacterium* (Hill *et al.*, 2018; Quigley, 2017) [16, 26].

Nutraceuticals with mucoprotective properties, such as glutamine and aloe vera, have been shown to have the ability to maintain the integrity of the gastrointestinal mucosa and promote healing in disorders like peptic ulcers (Déchelotte *et al.*, 2013; Yusuf *et al.*, 2014) [10, 34]. Furthermore, polyphenols' antioxidant qualities support the

maintenance of the mucosal barrier's functionality by lowering oxidative stress and inflammation in the gastrointestinal system (Pastoriza *et al.*, 2016) [25].

Nutraceuticals have been shown to have specific uses in anything from managing gastroesophageal reflux disease (GERD) using deglycyrrhizinated licorice to supplementing with fiber for bowel regularity (Bijkerk *et al.*, 2009) [4]. The key ingredient in turmeric, curcumin, has potential for treating inflammatory bowel conditions and offers a safe, all-natural method of lowering intestinal inflammation (Lang *et al.*, 2019) [21]. Furthermore, the potential of nutraceuticals such as cranberry extracts and mastic gum to prevent *Helicobacter pylori* infection and related gastrointestinal diseases has been investigated (Cellini *et al.*, 2014; Shmuelly *et al.*, 2012) [9, 28].

Certain herbal extracts, like peppermint oil, provide relief from symptoms associated with functional gastrointestinal diseases, while fiber supplements, such psyllium husk, help maintain intestinal regularity (Bijkerk *et al.*, 2009; Hawrelak & Myers, 2010) [4, 14]. The potential therapeutic uses of aloe vera are further highlighted by its gastroprotective actions, which include enhancing mucosal protection and expediting the healing of stomach ulcers (Yusuf *et al.*, 2014) [34].

To sum up, for those looking for supplementary or alternative therapies to conventional medical treatments for gastrointestinal tract disorders, nutraceuticals provide a strong option. The specific functions and best uses of these substances will become more apparent as this area of study develops, opening the door for individualized and focused gastrointestinal treatments.

## Conclusion

Examining nutraceuticals in relation to disorders of the gastrointestinal tract shows a complex environment in which supplements or food-based bioactive substances have a range of impacts that help maintain and enhance gastrointestinal health. Upon delving into the extensive discourse surrounding the impacts of nutraceuticals, it becomes apparent that these substances provide a sophisticated and comprehensive strategy for managing an array of ailments, ranging from peptic ulcers and functional disorders to inflammatory bowel diseases (IBD) and irritable bowel syndrome (IBS).

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