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Effects of BPA on The Gastro Intestinal Track (Git)

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ABSTRACT
This review paper provides a comprehensive analysis of the effect of Bisphenol A (BPA) on the gastrointestinal tract (GIT). The GIT is an essential system that plays a vital role in overall gut health, particularly nutrient absorption, and digestion. Concerns have been raised about the potential negative effects of BPA on human health. BPA is a widely used industrial chemical in plastic products, mainly polycarbonate plastics. Present review begins with an overview of BPA and how common it is in consumer goods. The broad effects of BPA on the GIT are further discussed, with special attention paid to how it affects oral health, esophageal function, gut microbiota composition, and gut barrier integrity. There is a thorough discussion of the specific effects of BPA on the stomach, small intestine, and large intestine. Furthermore, the connection between BPA exposure and stomach health are well documented. It has also been highlighted how BPA exposure affects the condition of the large intestine. BPA's effects on the gastrointestinal tract (GIT) should be examined due to its widespread presence in consumer plastic products, its propensity to migrate away from the polymer in certain environmental circumstances, and its capacity to aggravate a number of gastrointestinal diseases. Understanding the mechanisms underlying these impacts and conducting a long-term investigation of BPA exposure's effects on the GIT are both necessary for defending human health. More research is needed to fully comprehend these pathways and look at prophylactic measures to decrease the harmful effects of BPA on the GIT.
Keywords: *Safety of plastic food storage containers, plastics and GI track, gastritis causes, hormone imbalance causes, in utero exposure of BPA, BPA and endocrine system*

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INTRODUCTION

The chemical compound bisphenol A (BPA) can be found in the plastics, including bottles, toys, food containers, and dental & medical equipment's [1]. Humans tend to be in contact with BPA via the digestive system due to the substance's ability to dissolve into foods through polycarbonate containers. The bloodstream carries BPA from the GI tract to other body parts, where it is dispersed. BPA is widely present in various bodily fluids and tissues of both animals and human beings, particularly in fetuses, adipose tissue, breast milk, saliva, and reproductive organs [1, 2].

BPA exposure among people remains nearly constant [3]. Around 96.2 per cent of test population, participated in the national sample of the American populace aged six and above had BPA in their urine, including an average geometric level of 2.6 g/L [4]. Experimental investigations on mammals have demonstrated that being exposed to low concentrations of BPA in utero can have a variety of impacts on endocrine-driven mechanisms related to development, metabolism, behaviour, fertility, and the likelihood of cancer. Additional consequences include, for instance, altered bone geometry [5], increased incidence of female mammary gland adenocarcinoma [6], reduced immune response [7], altered hormone levels [8], a disturbed development of male and female reproductive organs [9], altered spatial learning[10] etc.,

Globally, GIT diseases become frighteningly common and have a bigger impact on the well-being of people. In this regard, colon cancer is currently a major factor in mortality as well as morbidity. Since colon cancer cases have continuously increased over time, it is important to look more closely at possible indicators of risk, such as environmental exposures [11]. Thus, it has been crucial to comprehend the part that BPA plays in GI Tract wellness and illness, considering its ubiquitous use and risk of exposure to humans.

The most common method by which people are exposed to BPA is one of the main reasons that the impacts of this chemical substance on the GIT ought to be evaluated. Although cutaneous and respiratory exposure

to BPA can happen, gastrointestinal seems to be the most frequent and major exposure route in people [12]. BPA has become widely ingested by men due to the migration of the chemical from containers used for storing food and beverages into consumable products. The risk of exposure is very high due to the migrational feature of BPA from the polymeric containers to food substances especially when they are subjected stress due to heat, extreme pH, or mechanical wear and tear. Since the GIT tract corresponds to where BPA first comes into interaction after ingestion, it is important to investigate how it may affect this important organ system [13].

This review attempts to provide information on BPA's potential effects on the GIT tract. Researchers can gain a better understanding of the effects of BPA exposure on human health by investigating its effects on both physiological processes and the emergence of GIT-related disorders. This study will advance our understanding of the possible dangers of exposure to BPA and offer insightful information for further investigations and public health initiatives, given the ubiquitous use of BPA-containing goods and the large burden of GIT disorders.

General Effect of BPA throughout the GIT Tract

The digestive system, often known as the gastrointestinal tract or GIT, plays a key role in digestion, nutrient absorption, gut barrier integrity, and general gut well-being [14]. Thermal paper receipts, food containers, and plastics all contain the industrial chemical BPA, widely used in everyday goods. Due to its pervasiveness in our everyday lives, concerns have been raised concerning for its possible effects on human health. BPA's ability to disrupt endocrine systems is giving rise to worries regarding its implications on human health, specifically in the GIT [15]. The impact of BPA on the gastrointestinal tract is particularly important since it affects immunological response, nutritional absorption, and general health [16]. The following sections review and explain the current body of knowledge about BPA's broad effects on the GIT tract, including both physiological processes and the emergence of GIT-related illnesses.

Effects on Oral Health

Oral health can suffer because of BPA exposure. According to studies, BPA can leak into the mouth cavity from dental products, including sealants and composites. Dental health may be impacted if BPA is ingested and absorbed because of this leaching. For example, BPA is linked to changes in salivary gland function that may lead to decreased saliva flow and a higher risk of dental cavities [17].

Effects on the Esophagus

The esophagus function of BPA can be affected. Exposure to BPA may decrease the movement of the esophageal tract and raise the likelihood of esophageal illnesses like gastroesophageal reflux disease (GERD), according to animal research. For instance, Yan et al. (2013) [18] subjected rats to BPA and discovered increased exposure to esophageal acid and decreased esophageal motility. These outcomes suggest that BPA may have a role in GERD development.

Effects on the Stomach

Gastric function is being proven to be affected by BPA exposure. According to studies, BPA may influence how much stomach acid is secreted, which can disrupt the process of digestion. For example, research on animals has shown that BPA exposure results in decreased gastric acid output, which may have an impact on how food is broken down and how nutrients are absorbed [19].

Effects on the Small Intestine

BPA exposure can interfere with the process of nutrients being absorbed in the small intestine, which is a critical area. BPA exposure has been linked to impaired food transporters in the small intestine and decreased nutrient absorption in vivo investigations. BPA may also compromise the intestinal barrier's integrity, leading to an increase in intestinal permeability and the possibility for hazardous chemicals to enter the circulation [20].

Effects on the Large Intestine

The large intestine may be impacted by BPA exposure. According to animal research, exposure to BPA can change the gut microbiota in the large intestine, which may cause dysbiosis and disruptions in gut homeostasis. In addition, exposure to BPA is linked to an increase in large intestine inflammation that might assist in the onset of inflammatory bowel illness [21].

Other Effects

Bioavailability and Absorption

The bioavailability and absorption of BPA after consumption have been examined in several number of studies. Human exposure to BPA can occur when it migrates from containers used for food and beverages into eaten goods. BPA is quickly absorbed after ingestion, mostly through the small intestine and stomach. Passive diffusion can pass through the intestinal epithelium and reach the bloodstream[1]. According to studies, BPA can enter the GIT and perhaps having an impact on the pancreas, liver, and fat tissue.

Gut Microbiota Alterations

A growing body of research indicates that BPA exposure may alter the makeup and operation of the gut microbiota, which is critical to the health and disease of the host. According to animal research [22, 23], BPA exposure can cause dysbiosis, which is characterized by a decline in good bacteria and a rise in harmful species. These changes in the makeup of the gut microbiota have been linked to several GIT-related diseases, such as colorectal cancer, irritable bowel syndrome, and inflammatory bowel disease.

GIT Inflammation and Barrier Dysfunction

Exposure to BPA has been linked to intestinal barrier dysfunction and GIT inflammation. BPA can cause the GIT to respond in a pro-inflammatory manner, increasing the production of inflammatory cytokines and activating immune cells [24]. This has been demonstrated in animal and in vitro investigations. BPA can also impair the intestinal epithelial barrier's integrity, allowing germs and toxins to enter the bloodstream, resulting in systemic inflammation, and perhaps promoting the growth of GIT disorders.

GIT-Related Diseases

Various experimental and epidemiological investigations have examined the possibility of a link between exposure to BPA and GIT-based illnesses. According to research [25], colon cancer is one of the most problematic GIT disorders and may be related to BPA exposure. It has been demonstrated that BPA increases colon cell proliferation, inhibits apoptosis, and causes DNA damage, offering a mechanistic understanding of its possible carcinogenic consequences. According to Snedeker[26], BPA exposure has also been linked to a higher risk of inflammatory bowel diseases such as Crohn's disease and ulcerative colitis. As a result of the effects, it has on immune cells and the microbiota in the gut, these illnesses are characterized by chronic GIT inflammation.

The available research concludes that BPA exposure may have a variety of consequences on the GIT tract. From its absorption and bioavailability to its effects on gut microbiota, inflammation, and barrier function, BPA possesses the ability to disturb GIT homeostasis, which may lead to the emergence of GIT-based illnesses.

Specific effects of BPA on the stomach

The major organ that makes up the digestive system is the stomach. Food breakdown, gastric acid secretion, and digestive enzymes occur in the stomach. The industrial chemical used to manufacture consumer goods, food containers, and plastics is Bisphenol A (BPA). There is an increased concern about the health effects caused by BPA because of its endocrine-disrupting properties. It is important to understand the effects caused by BPA on the stomach since it plays a significant role in nutrient absorption and digestion.

Animal models were used in *in vivo* studies where insights on the effects of BPA in the stomach were provided. Previous studies have revealed that the probity of the gastric mucosal barrier can be disrupted when exposed to BPA, which eventually leads to raised susceptibility and permeability damage. For instance, Al Omairi et al. (2018) [27] conducted a study where rats were exposed to BPA. Alterations were seen in the tight junction proteins, and increased permeability in the gastric mucosal barrier was observed. These observations were important to maintain the functional barrier of the stomach. Harmful substances get easily penetrated because of these changes where gastric inflammation and related disorders occur. The exposure to BPA is related to the changes made in gastric acid secretion.

Arambula et al. (2017)[28] conducted a study where BPA was exposed to mice, and a decrease in gastric acid secretion was observed along with the changes made in the acid-related genes. Alterations in the secretion of gastric acid affect the process of digestion, resulting in gastric disorder that includes gastric ulcers and gastritis. In addition to that, in animal models' gastric inflammation was observed because of inducing BPA.

Inagaki et al. (2012)[29] conducted a study where BPA was induced in rats. An enhanced level of inflammatory markers was observed in the stomach, including pro-inflammatory cytokines. This inflammation leads to the proliferation and growth of gastric disorders.

Cell culture models were used in the *in vitro* studies where certain effects of BPA in the stomach were elucidated. The gastric epithelial cells are affected directly when exposed to BPA, which is revealed in many studies, and various cellular processes are disrupted. For instance, in a survey conducted by Luo et al. (2019a)[30], human gastric epithelial cells are exposed to BPA. It was observed that the permeability was increased, the expression of the tight junction protein was impaired, cell morphology was altered, and gastric barrier function was disrupted. Anyhow, *in vitro*, models showed the effect of gastric acid secretion because of the exposure towards BPA.

Matsushima et al. (2010) [31]conducted a study where BPA was exposed to gastric cancer cells of BPA, where altered expression of genes was expressed, and the secretion of gastric acid was involved. There were some disturbances in the production of gastric acid, eventually leading to gastrointestinal tract complications.

Still, it is necessary to understand the specific mechanisms done by BPA and its effect on the stomach. BPA can collaborate with estrogen receptors, including estrogen receptor alpha (ERα) & estrogen receptor beta (ERβ). These two receptors are in the gastric epithelial cells, influencing cellular function and gene expression. In addition to that, other signaling pathways are disrupted by BPA. It includes modulation in immune response and induced oxidative stress, vital in affecting the stomach.

There are some health complications when BPA is exposed to the stomach. The gastric mucosal barrier is disrupted, which leads to enhanced permeability and penetration of harmful substances. These effects result in gastric inflammation and other disorders related to it. The secretion of gastric acid is altered where the digestive process is affected, contributing to gastric ulcers, gastritis, and other disorders. In addition, the inflammation caused by BPA worsens and leads to the progression and development of these issues.

There are extensive studies of the BPA effect on different organs and systems where the impact towards it is specific and is not studied as it is expected. The major aim of the present study is to discuss and summarize the effect of BPA on the stomach, which focuses mainly on three things, which include "Carcinogenic", "Metabolic," and "Toxic."

Carcinogenic Effects

The study examines the potential carcinogenic effect of BPA on the stomach. It is evident that certain studies conducted in animal models prove that exposure to BPA can lead to gastric tumorigenesis. It is also revealed that BPA induces the growth of pre-neoplastic lesions in animal models, which includes intestinal metaplasia and gastric dysplasia [32, 33]. The potential of BPA is attributed to these effects, which disrupt the proliferation of the cell, DNA repair mechanisms and apoptosis in the gastric mucosa of the stomach. Moreover, the enhanced risk of gastric cancer is related to exposure to BPA in the studies in epidemiology. However, further research is required to establish a determinate causal relationship[34].

Metabolic Effects

Exposure to BPA has been associated with the alteration that occurs in the metabolism in the stomach. It was demonstrated by the studies conducted in animal models that the secretion of gastric acid and gastric motility can be disrupted when BPA is induced [35, 36]. The contractile activity of the smooth muscles in the stomach is affected because of the effect of BPA, which leads to alterations in the patterns of gastrointestinal motility [36]. In addition to that, the alterations in the secretion of gastric acid have been related to exposure to BPA, where the digestion process is potentially affected along with the regulation of gastric pH [35]. The effects of BPA in the stomach may have different implications for the absorption of nutrients and other digestive functions.

Toxic Effects

In many studies, the effect of toxins is exerted because of the BPA on the stomach. In animal models, exposure to BPA in the gut leads to damage to gastric mucosa, including ulceration, erosion, and degeneration of epithelial cells [34]. The major media in toxic effects is the gastric mucosal barrier disruption, inflammation, and oxidative stress. The production of reactive oxygen species (ROS) has been increased because of the impact of BPA in the stomach, which results in the oxidative disruption of the gastric mucosal barrier [19]. Furthermore, inflammation is induced by BPA in the stomach, where the inflammatory signaling pathways are contributed, and the injury of gastric tissue is contributed [12].

Therefore, specific effects can be exerted on the stomach, including potential carcinogenic, metabolic, and toxic products in the suggested literature. The exposure of organs towards BPA leads to the disruption in the secretion of acid, and gastric motility, inducing damage in the gastric mucosal barrier and promoting gastric tumorigenesis, a condition where there will be a proliferation of neoplastic cells. These findings reveal the significance of understanding the risks related to exposure to BPA. Thus, further study must be done where the underlying mechanism is elucidated, and preventive measures are established.

Specific effects of BPA on the small intestine

The digestive system's most critical component is the small intestine, which is responsible for water, electrolyte, and nutrient absorption. Three sections are consisted of it, which include the duodenum, jejunum, and ileum.

Exposure to BPA reduces the absorption of nutrients by the small intestine as BPA interferes with nutrient absorption and was proven in the experiment conducted with mice [37]. Similarly, BPA also influences composition of gut microflora in mice[38]. The symbiotic relationship between the gut microbiota and the host has been changed because of the disruption it has caused, where the gut health is affected potentially, and the development of disorders in the gastrointestinal tract is also affected.

Further understanding is needed of specific mechanisms that occur because of the effect of BPA on the small intestine. Interaction occurs between BPA and estrogen receptors, including estrogen receptor alpha (ERα) and estrogen receptor beta (ERβ), which is present in the epithelial cells of the intestine and influences cellular function and gene expression. In addition to it, hormone receptors have been affected

by BPA, where the signaling pathways are disrupted, and oxidative stress is induced along with the contribution of BPA to the small intestine.

BPA specifically affects the small intestine because it has significant health implications. The integrity of the intestinal barrier is disrupted, which eventually leads to enhanced permeability, where the passage of harmful substances is allowed to enter into the blood, and systemic inflammation is triggered. In the small intestine, when absorption of nutrients is impaired, it results in several metabolic disorders and nutrient deficiencies. In addition, in the composition of gut microbiota, the delicate balance is disturbed in the microbial environment, resulting in gastrointestinal disorders and dysbiosis of the entire gut.

The BPA effects have been explored extensively in this research on various systems and organs where the BPA has a specific impact on the small intestine, which is only being studied once it is expected. The following has discussed and summarized the effects of BPA on the small intestine, including toxic, carcinogenic, and metabolic effects.

Toxic Effects

In the small intestine, exposure to BPA has exerted certain toxic effects. The studies conducted in animal models have demonstrated that exposure to BPA can induce functional and structural alterations in the mucosa of the small intestine. The proteins from the tight junctions are disrupted, permeability is increased, and villus blunting are the effects caused by BPA [37, 39]. Inflammation and oxidative stress have been induced by BPA, which was proposed by the mechanisms underlying these toxic effects. Exposure to BPA has enhanced reactive oxygen species (ROS) production, leading to inflammation in the small intestine. This leads to compromised barrier function and damage in the mucosa [40].

Metabolic Effects

Perng et al. [41] stated that Small intestinal changes in metabolism had been linked to BPA exposures. According to animal research, BPA may interfere with nutrient uptake and metabolic processes in the small intestine. Huang et al. [42] studied that exposure to BPA decreases the amount and activity of nutrient transporters such as glucose transporters (GLUTs) and amino acid transporters (AATs), which affects nutrient intake. In addition, BPA consumption has been linked to changes in the metabolism of lipids and the gut-brain axis, which may influence the regulation of energy expenditure and metabolic balance [43, 44].

Carcinogenic Effects

Luo et al. [45]reviewed the studies that are being done on the propensity of BPA to cause colon cancer. Animal and laboratory studies have shown that BPA exposure can promote the development of small intestinal tumours. Additionally, small intestinal epithelial BPA has been shown to induce cell proliferation, inhibit apoptosis and induce DNA damage. These hormonal properties of BPA and its ability to interact with receptors for hormones in the small intestine may account for these side effects determined by López-Cima et al. (2012)[46].

Choi et al. (2015)[47] identified that epidemiological findings and further investigations are needed to show a clear causal link between BPA use and elevated risk of intestinal tumours. The research that is now obtainable indicates that BPA can have a specific impact on the small intestine, including harmful metabolism and perhaps cancer-causing consequences. BPA exposure was linked to small intestine cancer, impaired food metabolism, and mucous injury. These results emphasize the significance of comprehending the hazards of BPA contamination and the need for more studies to clarify the basic procedures and devise preventative strategies.

Specific effects of BPA on the large intestine

Rubin (2011) [48] explained that the large intestine, commonly referred to as the large intestine, is an important part of the digestive system responsible for absorbing water, electrolytes, and stool. It is lined by a single layer of cells called epithelial cells, which act as a barrier to protect the body and help pass nutrients while blocking the path of dangerous substances. Bisphenol A (BPA) is often used to produce plastics, resins, and various consumer products. Because BPA has been shown to have endocrine-disrupting properties, there are concerns about its potential harm to people's well-being. Although the adverse effects of BPA on many systems and organs have been thoroughly investigated, the impact of BPA, specifically on the large intestinal tract, has received relatively little attention.

Vandenberg et al. (2013)[49] defined that the organ is essential for water consumption, the balance of electrolytes and stool production, and it is important to understand the exact impact of BPA on the large intestine. Uncertainty remains regarding the precise mechanisms underlying the effects of BPA on the large intestine. BPA has the potential to affect humans through both estrogenic and non-estrogenic pathways. BPA can affect gene transcription and cell metabolism by binding to estrogen receptors in gut cells as a hormone disruptor. Furthermore, BPA can affect additional estrogen receptors, including testosterone and thyroid gland hormones, which may exacerbate its effects on the large intestine. The harmful effects of BPA in the intestinal tract are additionally linked to epigenetic changes. Exposure to BPA can modulate DNA

trends in histone modification and methylation, which affect how genes are expressed and how cells function. The persistent impact of BPA on the intestinal tract and its association with intestinal conditions may result from these epigenetic changes. In addition, it has been suggested that oxidative stress and inflammation may be factors underlying how BPA affects the intestinal tract. BPA exposure can generate reactive oxygen species (ROS), which can cause oxidative stress and damage biological tissues. The intestinal barrier can be damaged, the makeup of the gut microbiome can change, and digestive problems can occur due to the inflammatory process and oxidative damage.

Bisht and Dada (2017)[38] provided the significant health consequences of the specific effects of BPA on the intestinal tract. Permeability problems resulting from impaired gut barrier function can allow dangerous chemicals to enter the circulation and fuel chronic inflammation. Changes in the makeup of the gut microbiota have been reported to cause gastrointestinal conditions, including IBD and colon cancer, by disrupting the delicate balance of microbiota in the environment. Inflammatory responses in the intestinal tract can exacerbate the onset and course of these diseases. Regulations have been implemented to restrict its use in response to concerns about possible adverse effects from contact with BPA. For example, the United States Food and Drug Administration (FDA) has banned the use of BPA in baby bottles and drinking straws, and many countries have restricted or outright banned its use in certain products. Safety requirements and restrictions on exposure are being developed to minimize BPA exposure; nevertheless, the impact of BPA on the large intestine is not adequately covered by current laws. The next section focuses on several subtopics: "toxic," "metabolic," and "carcinogenic". It attempts to summarize and explain the current corpus of data on the specific effects of BPA on the colon.

Toxic Effects

Ma et al. (2020)[50] determined that BPA has recently been shown to be toxic to the large intestine, and exposure to BPA can cause functional and structural changes in the large intestine tissues, as demonstrated by animal and in vitro studies. Destruction of epithelial cells, inflammatory processes, and breakdown in barrier function are some effects [51]. Inflammation and oxidative stress brought about by BPA are hypothesized as the underlying causes for these harmful effects. Reactive oxygen species (ROS) are known to cause oxidative damage in the gut and have been linked to BPA exposure. According to Miyata et al. (2017)[52], BPA can stimulate inflammatory signalling systems and promote the production of pro-inflammatory cytokines, contributing to large intestinal inflammation.

Metabolic Effects

Zhang et al. (2020) [12] showed that the metabolism of the large intestine had been shown to change after exposure to BPA. Animal research indicates that BPA can interfere with gastrointestinal absorption and metabolic processes. According to studies conducted by Bouwmeester et al. (2016)[53], exposure to BPA reduces the amount and activity of nutrient exchangers in the large intestine, affecting the digestion and absorption of water, vitamins, and electrolytes. According to BPA, exposure is associated with variations in the number and types of gut microbiota and dysbiosis. These two conditions affect the makeup of bacteria in the colon. Colonic metabolism may be affected by BPA, which may have effects on colonic health and general intestinal health.

Carcinogenic Effects

Chen et al. (2016)[34] conducted on the potential of BPA to cause colon cancer, and there is evidence from epidemiological and animal studies that exposure to BPA may promote the development of colon tumors. Zhang et al. (2019b)[54] studied that BPA damages DNA, induces cell growth, and inhibits apoptosis in the large intestinal epithelium. BPA's ability to engage with receptors for estrogen and alter hormone signaling in the large intestine may account for these side effects. Epidemiological studies have linked an increased risk of colon cancer to an association with BPA. However, more research is needed to link BPA exposure to the occurrence of colorectal cancer, definitive by Kong et al. (2016)[55].

In summary, research reveals that BPA may have unique effects on the large intestine, including potentially fatal, metabolic, and carcinogenic effects. Exposure to BPA has been found to harm the mucosa, inhibit nutrient absorption and metabolic processes, and promote the development of gastrointestinal tumors. These results highlight the value of understanding the potential risks associated with the ingestion of BPA and the need for further research to clarify underlying mechanisms and devise prevention strategies from Wang et al. (2021)[56].

CONCLUDING REMARKS

Consequently, both scientific interest and serious concern have focused on the effects of BPA on the GIT. The GIT is essential for digestive function, nutrient intake, and gut health in general. In the GIT, BPA, a widely used commercial toxin found in various commercial products, has been found to contribute to future health risks for humans. Experiments show that exposure to BPA can affect multiple bodily functions, including esophageal function, stomach acid output, gut wall integrity, and the makeup of the gut

microbiota. Tooth decay, gastric reflux disease, poor digestion, malnutrition, and a condition known as inflammatory bowel disease are some gastrointestinal problems these impacts can exacerbate.

The mechanisms explaining how BPA affects GIT are not fully understood. BPA can alter gene expression, interact with estrogen receptors, and interfere with multiple signaling channels. In addition, it has been suggested that oxidative damage and immune regulation may act as potential pathways through which BPA affects the GIT. The most recent safety regulations and recommendations have been implemented to control BPA exposure in consumer products. These laws should consider the potential impact of BPA on the GIT in more detail.

Further investigation is needed to fully understand the underlying mechanisms and assess the long-term effects of exposure to BPA in GIT. Future research investigations are required to prove the link between BPA exposure and the onset of certain human digestive problems. Studies should also explore preventive measures and alternatives to reduce BPA exposure and mitigate its adverse effects on GIT. It raises questions about how the effects of BPA on the GIT may affect the well-being of individuals in general. They protect everyone's well-being and improve gastrointestinal health, and it is essential to identify and address the potential risks associated with BPA consumption throughout the GIT.

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Conflict of Interest

We declare that we have no conflict of interest.

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