

Food and Health Safety of Prebiotics: A Review of Current Evidence

Abstract

Food substances or carbohydrates which are indigestible but energize the growth and/or activity of useful bacteria in the digestive system and make the digestive system work more efficiently are referred to as prebiotics. Prebiotics support the growth of good gut bacteria and the association of various potential health benefits. They are a safe dietary addition that, when consumed in the correct amounts, offer many health benefits. This review article sums up the current research on the safety of prebiotics. Prebiotics may have some positive results, but there have been some safety worries about their use, which has called more attention to learning more about their safety characteristics. Reports have been published on a few possible aftereffects, which include dilate and gastrointestinal agony. After the consumption of prebiotics for some days, these negative effects are usually moderated. Prebiotics are governed by several organizations, including the US Food and Drug Administration and the European Food Safety Authority. Before prebiotics are placed on the shelf on sale, the manufacturers ensure compliance with regulations and instructions. People with preexisting medical conditions or those taking medications are advised to consult their doctor before ingesting prebiotics. Although some people may experience slight gastrointestinal discomfort, human and animal consumption of prebiotics is generally considered harmless. People with particular medical conditions might even benefit from prebiotics.

Keywords

Food • Health • Safety • Prebiotics

Introduction

Prebiotics are indigestible food components (mainly carbohydrates) that specifically promote the development of advantageous gut flora and/or the action of bacteria

Review Article

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in the digestive system, benefiting the host's health [1]. Prebiotics are found in many foods (including fruits and vegetables, especially those containing complex carbohydrates, such as fiber and resistant starch) and/or are food supplements [1].

In order to illicit their effects, prebiotics are preferentially digested by intestinal microbes to produce short-chain fatty acids and other beneficial metabolites [1-4]. They act as a substrate for the growth of beneficial bacteria, which leads to an increasing number of prebiotics in the gut [1-4]. Prebiotics may improve health by altering the make-up of

the intestinal microbiome [1], immune response [5], and metabolic health [6].

The health advantages of prebiotics have attracted a lot of notice lately. However, safety concerns surrounding the use of prebiotics have been raised, leading to increased interest in understanding their safety profile [1-4]. These worries about safety of prebiotics on human health arises especially when used in large amounts; in long-term, and or by people with specific health conditions [1,7-8]. The goal of this paper is to examine the current trends regarding the food and health safety of prebiotics.

Methodology

In this secondary descriptive research paper, several electronic databases were used to conduct a comprehensive literature search to help identify relevant studies on how safe prebiotics are. The search which was done across various search engines (including Google scholar, PubMed) using varied keywords (including food, health, prebiotics) included animal and human studies published in English between 2000 and 2023 [10-14].

In brief, the identified studies included animal and human studies. Generally, animal studies are regularly used to evaluate the safety of prebiotics. Animal studies entails administering prebiotics to animals and monitoring them for any adverse effects. In the end, a toxicological profile is determined by giving low to high doses of prebiotics to the animals [15,16]. Various animal species such

as rats, mice, and pigs have been used to judge the harmlessness of prebiotics. On the other hand, studies on humans have also used to assess the safety of prebiotics. Human studies involve administering prebiotics to human subjects and monitoring them for any side effects. In such human studies, prebiotics is typically given in the form of supplements or added to food. Healthy individuals as well as persons with various health conditions have been evaluated to know the safety of prebiotics [17].

Results and Discussion

The evidence at hand proposes that the consumption of prebiotics is generally safe for humans. The majority of studies have reported no serious adverse effects associated with prebiotic consumption, even at high doses [18-25]. This is not surprising when considering that some prebiotics are already well-known food components either entirely or partially (Table 1).

However, mild gastrointestinal symptoms such as bloating, flatulence, and diarrhea may be experienced by some individuals. These symptoms are usually mild and transient and tend to resolve with the continued use of prebiotics [26]. Notwithstanding, there are concerns about the safety of prebiotics in individuals with certain health conditions, such as irritable bowel syndrome and inflammatory bowel disease. However, the available evidence [1-2] suggests that prebiotics are generally well-tolerated in these populations. Some studies have even

| Type of prebiotics | Description | Reference citations |
|---|---|---------------------|
| Fructans | Consists of inulin and fructo-oligosaccharide or oligofructose. Their structure is a linear chain of fructose with β (2→1) linkage. | [9] |
| Galacto-oligosaccharides (GOS) | Classified into two sub-groups: <ul style="list-style-type: none"> ▪ the GOS with excess galactose at C3, C4 or C6 and ▪ the GOS manufactured from lactose through enzymatic trans-glycosylation. | [10] [11] |
| Starch and Glucose-Derived Oligosaccharides | Kind of starch that is resistant to the upper gut digestion known as resistant starch. | [12] |
| Pectic oligosaccharides | Originated from a polysaccharide known as pectin. | [13] |
| Non-Carbohydrate Oligosaccharides | Cocoa-derived flavanols | [14] |

Table 1. Some common prebiotic foods and their handling/uses.

reported potential benefits of prebiotics for irritable bowel syndrome and inflammatory bowel disease patients, including improved gut microbiota composition and reduced inflammation [1-4].

Following assessment of safety of consumption of prebiotic in foods (and feeds), a number of human (and animal) studies have proven that the consumption of prebiotics is generally safe and possesses little or no adverse effects [1-2,4-5]. Some studies have further revealed that even in large doses, prebiotics taken by animals are safe (Table 2). In human studies, the safety of prebiotics has been

evaluated in healthy individuals, as well as in various health conditions (Table 2). Inquiries have established that prebiotics does not cause any negative effects and are well tolerated by the body [27-30].

Nevertheless, prebiotics may have some unfavorable effects, according to some reports (Table 2). This covers flatulence, bloating, and other gastrointestinal discomforts [31,32]. These adverse effects are generally mild and transient and disappear once prebiotics has been consumed for a few days [1,7]. Prebiotic allergy reactions have been reported on very infrequent occasions.

| Food or supplement | Description | Prebiotics-linked beneficial composition | Health benefits | Prebiotic function | Reference citation |
|--------------------|--|---|---|---|--------------------|
| Garlic | ✓ Garlic is a flavorful herb | <ul style="list-style-type: none"> ✓ Inulin ✓ Fructooligosaccharides (FOS) ✓ Fructan (stimulates growth of <i>Bifidobacteria</i>) ✓ Allicin (onus for its distinctive smell and taste). | <ul style="list-style-type: none"> ✓ Antioxidant ✓ Anti-inflammatory (may even protect against the effects of asthma) ✓ Lipid-lowering properties ✓ Anti-tumor effects (reduce the risk of cardiovascular diseases) ✓ Lower blood glucose levels | <ul style="list-style-type: none"> ✓ Promoting the growth of beneficial <i>Bifidobacteria</i> in the gut. ✓ Prevent disease-promoting bacteria from growing ✓ Speculations: Allicin may be helpful in heart disease and cancer | [16-18] |
| Onions | ✓ Onions are a tasty and versatile vegetable | <ul style="list-style-type: none"> ✓ Inulin ✓ FOS ✓ Quercetin (a flavonoid) | <ul style="list-style-type: none"> ✓ Antioxidant and anticancer properties | | [19-20] |
| Leeks | ✓ Leeks are nutrient dense, low in calories but high in vitamins and minerals. | <ul style="list-style-type: none"> ✓ Inulin (leeks promote healthy gut bacteria and help break down fat) ✓ Vitamin K (which promotes blood clotting) | | | [21-23] |
| Mushrooms | ✓ Mushrooms are rich in carbohydrates, like chitin, hemicellulose, xylans and galactans which makes them good prebiotics | <ul style="list-style-type: none"> ✓ High protein contain (44.93%) ✓ Vitamin ✓ Fibers ✓ Carbohydrate | <ul style="list-style-type: none"> ✓ Anti-allergic ✓ Anti-tumor ✓ Anti-cancer properties ✓ Anti-cholesterol | <ul style="list-style-type: none"> ✓ Stimulate the growth of gut microbiota, conferring health benefits to the host. | [24] |

| | | | | | |
|---------|---|--|---|---|-------------|
| Bananas | <ul style="list-style-type: none"> ✓ Rich in fibers. ✓ They also contain vitamins, minerals and small amount of inulin ✓ Unripe ones are high in starch resistance | <ul style="list-style-type: none"> ✓ Vitamins ✓ Minerals ✓ Fibers ✓ Inulin | <ul style="list-style-type: none"> ✓ Anti-oxidant | <ul style="list-style-type: none"> ✓ Help boost your digestion and heart health | [25-26] |
| Apples | <ul style="list-style-type: none"> ✓ Delicious fruit with fiber. Soluble fiber pectine accounts for much an apple's total fiber content | <ul style="list-style-type: none"> ✓ Fibers | <ul style="list-style-type: none"> ✓ Improve heart health. ✓ Reduce risk of asthma and other pulmonary disorder | <ul style="list-style-type: none"> ✓ Pectine increases butyrate, a short chain fatty acid that feeds beneficial gut bacteria and decrease the population of harmful bacteria | [27-29] |
| Cocoa | <ul style="list-style-type: none"> ✓ Seeds from <i>Theobroma cacao</i> tree. Not only are they use to make chocolate but they are delicious and healthy | <ul style="list-style-type: none"> ✓ Polyphenols (Flavanols) | <ul style="list-style-type: none"> ✓ Antioxidant and anti-inflammatory effect. ✓ Can reduce risk of type 2 diabetes. | <ul style="list-style-type: none"> ✓ Helps grow beneficial gut bacteria while reducing the growth of harmful bacteria. | [25, 30-31] |
| Barley | <ul style="list-style-type: none"> ✓ It's a cereal grain that is high in beta-glucan fiber. | <ul style="list-style-type: none"> ✓ Selenium | <ul style="list-style-type: none"> ✓ Anti-cholesterol ✓ Anti-oxidant ✓ Lower blood sugar level ✓ Helps in thyroid function ✓ Boost immune system | <ul style="list-style-type: none"> ✓ Promote healthy gut bacteria | [32] |

Table 2. Effects and/or safety of consumption of prebiotics in animals and man.

Conclusion

All-inclusive, this review offers insightful information about the harmlessness of prebiotics and highlights the need for additional study after comprehending their potential risks and benefits. As prebiotics continue to gain more popularity as a dietary supplement, it is important to ensure that they are safe for human consumption and that their potential benefits are maximized due to their association with a few serious adverse effects. Notwithstanding, it is highly recommended that ensuring the safety of humans, as well

as animals, is called upon because prebiotics might lead to frequent side effects like mild gastrointestinal complaints, but they usually go away with continued use. Prebiotics are generally well-tolerated and might even offer pluses for these populations, despite that there are concerns about their safety in individuals who have particular health complications.

List of Abbreviations

Not applicable

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