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The Benefit of Diverse Fibre Prebiotics for Gut Health and Growth & Development

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***ABSTRACT*:** Good gut health is essential to the well-being of the body, as the gut plays a role in digestion, nutrient absorption and immune system regulation. An imbalance in the gut microbiota can lead to digestive disorders, inflammation and decreased immunity. Prebiotics are compounds that cannot be digested by the human body, but can be utilized by beneficial gut microorganisms, such as probiotic bacteria. Prebiotics serve as a food source for good bacteria, support their growth, and maintain the balance of gut microbiota. This review aims to discuss the benefits of fiber prebiotics, specifically FOS:GOS 1:9 and Inulin, in supporting gut health and growth and development. The results showed that naturally founded prebiotics in various foods have an important role in promoting the growth of beneficial gut bacteria. Fiber prebiotics such as FOS:GOS 1:9 and Inulin act as "fertilizer" for beneficial and nourishing the gut microbiota, especially bifidobacteria and lactobacilli, which play a role in maintaining digestive health. These prebiotics help to improve the balance of the gut microbiota, which in turn supports a healthy body. Proper dosing is essential for optimal benefits from prebiotics.

Keywords- Prebiotics, fiber, FOS:GOS 1:9, Inulin, gut health, growth and development.

INTRODUCTION

Gut health plays a very important role in maintaining the balance of the body's overall function. The function of the gut is not only limited to food digestion and nutrient absorption, but it is also the center of microbiota balance that influences the immune system, metabolism, and mental health. The gut microbiota, especially the bacteria that inhabit this ecosystem, plays a crucial role in supporting immunity, nutritional processes and development of the human body (Hasibuan & Kolondam, 2017). In the human gut, there are approximately 100 trillion microbiota cells consisting of more than 1,000

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different species. The microbiota is a collection of microorganisms that live symbiotically in the human body, including the gut, and the term is often used interchangeably with "microbiome." Most of the human microbiome is concentrated in the gastrointestinal tract, making the gut the center of life for these microorganisms (Dietert, 2015).

One effective way to support gut health is by consuming prebiotic fiber. Prebiotic fibers are complex carbohydrates that cannot be digested by the human body, but serve as a source of nutrients for good bacteria or probiotics that live in the gut. Through metabolism by gut microorganisms, prebiotics such as inulin, oligofructose, and galacto-oligosaccharides are able to modulate the composition and activity of the microbiota, resulting in physiological effects beneficial to host health (Bindels et al., 2015). Research shows that these fibers stimulate the growth of good bacteria, such as Bifidobacterium and Lactobacillus, which contribute to a balanced gut environment (Davani-Davari et al., 2019). A healthy gut environment not only supports nutrient absorption and boosts the immune system, but also reduces the risk of digestive disorders. In children, prebiotic consumption also supports growth, optimal development and immune system strength.

Among soluble dietary fibers, fructooligosaccharides (FOS) and galacto-oligosaccharides (GOS) are known to be effective in stimulating the growth of beneficial microbiota. The combination of FOS and GOS given in a certain ratio, such as 1:9, has been recommended by the European Commission (EC) for use in infant formula at 0.8 g/100 ml. This combination has been shown to have a significant positive impact on gastrointestinal health and modulation of immune responses (Miqdady et al., 2020). In addition, inulin, which is also a type of soluble fiber, has strong prebiotic properties. Inulin is known to increase the concentration of short-chain fatty acids (SCFAs), such as acetate, propionate and butyrate. These fatty acids play an important role in maintaining gut health and benefit growth and development (Sheng et al., 2023).

From this mechanism, prebiotic fibers such as FOS, GOS, and inulin are important components in supporting gut health and optimal growth and development. Previous research has shown that prebiotic fibers have a variety of health benefits, although not all categories of fibers have the same effect in human studies. In general, all types of prebiotic fibers are known to promote digestive health due to the fermentation process that occurs in the gut. Scientific evidence shows that eight categories of prebiotic compounds, through their metabolism in the colon, provide significant health benefits (Carlson et al., 2018).

Furthermore, other studies provide evidence that prebiotic fibers such as inulin, oligofructose (OF), lactulose, and resistant starch (RS) meet the criteria for being prebiotics, including their ability to stimulate

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the growth of Bifidobacterium, one of the bacteria beneficial to health. In addition, some isolated carbohydrates and other carbohydrate-containing foods, such as galactooligosaccharides (GOS), transgalactooligosaccharides (TOS), polydextrose, wheat dextrin, acacia gum, psyllium, banana, whole wheat, and whole corn, have also shown prebiotic effects that support gut health (Slavin, 2013).

This review aims to discuss the importance of diverse soluble dietary fibers, with particular emphasis on the combination of Fructooligosaccharides (FOS) and Galacto-oligosaccharides (GOS) in a 1:9 ratio, as well as inulin. This combination is considered to have great potential in supporting the balance of gut microbiota and supporting optimal child development. By highlighting the importance of choosing the right type of fiber, this review can provide a deeper understanding of how certain soluble dietary fibers affect gut health and help optimize nutrient intake at different stages of development. The results from this review are expected to contribute to the development of more effective nutritional strategies to support general public health.

METHODS

This research uses a narrative review approach, which is a method for reviewing literature by summarizing key studies. In a narrative review, the researcher attempts to organize conclusions based on analysis of relevant sources. This method also takes into account existing theories, which help to provide context and a deeper understanding of the topic under study (Demiris et al., 2019). In this review process, data collected from various references are carefully and systematically analyzed to build a solid theoretical foundation. This theoretical foundation is not only useful to strengthen the arguments in the research, but also to provide a relevant basis to support the findings. Thus, the narrative review helps the researcher to develop a more holistic and structured picture of the phenomenon or problem being studied.

DISCUSSION

Prebiotics are found naturally in a wide variety of foods and serve to encourage the growth of good bacteria in the gut, which in turn promotes digestive system health. The term prebiotic refers to a substrate that is selectively utilized by microorganisms in the host body to provide health benefits (Sitorus et al., 2021). Prebiotics are made up of fibers that cannot be digested by the human body, but play an important role in supporting a healthy balance of gut microflora. The gut microbiota has a close relationship with the immune system and cognitive function in children. Research shows that gut microbiota affects innate and adaptive immunity, as well as cognitive function through mechanisms such

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as the HPA axis, metabolites, vagus nerve, neurotransmitters and myelination processes (Kartjito et al., 2023).

Therefore, the role of prebiotics is critical in supporting these relationships, especially to support optimal development in children. However, while all prebiotics are a type of fiber, not all fibers can be called prebiotics. For a food ingredient to be categorized as prebiotic, scientific evidence is needed to show that it meets certain criteria (Pandey et al., 2015). Ideal prebiotic criteria include:

1. Not hydrolyzed or absorbed in the upper gastrointestinal tract;
2. Can be a substrate for at least one good bacteria in the colon, thus stimulating the growth and activity of these bacteria;
3. May help balance the microflora composition in the colon;

Fructo-Oligosaccharides (FOS), Galacto-Oligosaccharides (GOS), and inulin are some of the most well-known types of prebiotics that have been widely researched in the health field (Dahiya & Nigam, 2022). These three types of prebiotics have become a major focus in health research due to their significant role in maintaining gut health and supporting growth and development that can contribute to human well-being (Kaur et al., 2021).

Some studies have shown that prebiotics are able to regulate hepatic lipogenic enzymes, which in turn increase the production of short-chain fatty acids (SCFAs) such as butyric and propionic acids through fermentation (Den Besten et al., 2013). These fermentation products are known to increase transcriptional gene expression and aid in the proliferation of beneficial gut microflora.

FOS (Fructo-Oligosaccharides) is a type of prebiotic found naturally in some fruits and vegetables, such as bananas, wheat, onions, and garlic. Besides being found in these foods, FOS can also be obtained from local foods in Indonesia, such as gembili, sweet potatoes, arrowroot potatoes, taro, and dahlia tubers (Cahyaningtyas & Wikandari, 2022). While GOS (Galactooligosaccharide) is a prebiotic similar to lactose in milk, but more resistant to heat. GOS is produced through transgalactosylation of lactose by the enzyme β-galactosidase which occurs in lactose-rich substrates, especially milk and milk whey (Kothari et al., 2014). GOS is stable to extreme pH and temperature conditions. The prebiotic effect of GOS has been widely accepted, and many studies have reported its positive influence on gut flora composition and activity (Krasaekoopt & Watcharapoka, 2014; Bruno-Barcena & Azcarate-Peril, 2015).

A study also reported that FOS and GOS were tested in vivo and met all the criteria required for effective prebiotics (Kaewarsar et al., 2023). This study showed that mixing prebiotics in an optimal ratio can stimulate the growth of probiotic bacteria and increase their activity. One combination that is considered optimal is the FOS:GOS ratio of 1:9, where the amount of GOS is nine times more than FOS.

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This combination is thought to support the growth of certain good bacteria in the gut, providing greater benefits to digestive health and well-being.

Meanwhile, inulin is another type of prebiotic that is often found in various plants, such as garlic, asparagus and wheat. This prebiotic is also naturally present in leeks, onions, wheat, chicory, oats, soy beans, and Jerusalem artichokes (Bindels et al., 2015). Inulin, a type of natural fiber, plays an important role in supporting digestive health.

A variety of different types of fiber is important because the good bacteria in the gut need a variety of foods to grow and develop properly. Just as the human body needs a variety of foods for balanced nutrition, the microbes in the gut also need a variety of fibers to support their health. A combination of different types of fiber can increase the effectiveness in supporting the growth of specific good bacteria, which in turn provides broader health benefits, such as improving the balance of gut microflora and supporting healthy digestion.

Soluble dietary fibers such as FOS:GOS 1:9 and Inulin have an important role in stimulating the growth of good bacteria, such as Bifidobacteria and Lactobacillus, which are needed to maintain a balanced gut microbiota. Research shows that Inulin and FOS can significantly increase the growth of Bifidobacteria, bacteria that support digestive health (Cahyaningtyas & Wikandari, 2022). Inulin supplementation not only maintains the activity and viability of some Lactobacillus strains, but also reduces the generation time of pathogenic bacteria such as Streptococcus and Lactobacillus, reinforcing the role of inulin in supporting healthy gut flora.

In addition, soluble fiber has the ability to be selectively fermented in the colon, where good bacteria use it to produce short-chain fatty acids (SCFAs). The SCFAs formed from this fermentation process have various health benefits, including modulating the gut microbiota. This process supports the production of important metabolites and extracellular polysaccharides (EPS) that contribute to healthy digestion. Prebiotics such as Inulin and FOS are more effective than regular fiber in influencing the gut microbiota and supporting overall body health (Gibson et al., 2017). SCFAs also play a role in lowering the pH in the gut, which can inhibit the growth of pathogenic bacteria. Beneficial gut microorganisms are able to produce antimicrobial compounds that fight pathogenic bacteria and aid in the degradation of prebiotics into oligosaccharides or monosaccharides. These compounds then bind to lectin receptors on the surface of intestinal epithelial cells, preventing colonization of pathogenic bacteria, and helping to prevent infection (Pourabedin, 2015).

Many studies have shown that FOS, GOS, and Inulin have various health benefits, especially related to the regulation of metabolic processes and digestive health. Inulin, as a type of prebiotic, is known to

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have the ability to regulate various metabolic processes, such as lowering blood lipid, cholesterol, and triacylglycerol levels. In addition, inulin plays a role in improving mineral absorption and altering the microbial balance in the digestive tract. Research also shows that inulin can affect the immune system, overcome constipation, and strengthen the digestive system against pathogenic bacteria and allergic factors (Cahyaningtyas & Wikandari, 2022).

Consumption of prebiotics such as FOS and GOS can affect the composition of the gut microbiota and metabolic activity. The molecular structure of these prebiotics plays an important role in determining their physiological effects, including the types of gut microbiota that can utilize prebiotics as carbon and energy sources. Several studies have shown that prebiotics have a positive impact in improving metabolic parameters associated with obesity, inflammation, impaired glucose homeostasis, and abnormal plasma lipid levels (Markowiak & Śliżewska, 2017). Prebiotics have also been shown to indirectly lower serum triglyceride levels and can affect mineral absorption in the colon. One other important effect is their ability to protect the body from inflammatory bowel syndrome by stimulating the production of short-chain fatty acids, such as butyrate, which is beneficial for colonic health.

Overall, prebiotics such as FOS, GOS, and Inulin function as “colonic foods” that support health through the colon microbiota by improving the gut microbial balance, which contributes to the improvement of the digestive system and metabolic functions of the body (Figueroa-Gonzalez et al., 2019). Therefore, FOS:GOS 1:9 and Inulin are important prebiotics that serve as “fertilizer” for good bacteria in the gut. So it is recommended that for optimal benefits, it is important to consume fiber-rich foods, such as fruits, vegetables, whole grains, and legumes. Prebiotic supplements containing FOS, GOS, and Inulin can also be an additional option, but it is important to consult a doctor or nutritionist to determine the right dosage and type of supplement that suits the body's needs, ensuring safe and effective consumption according to individual health conditions.

CONCLUSION

Research shows that prebiotics, found naturally in a variety of foods, play an important role in promoting the growth of good bacteria in the gut, which in turn supports digestive system health and human development. Fiber prebiotics such as FOS:GOS 1:9 and Inulin act as “fertilizer” for the good bacteria in the gut, providing nutrients needed by the gut microbiota, particularly bifidobacteria and lactobacilli, which play a role in maintaining digestive health. By stimulating the growth of these good bacteria, prebiotics help to improve the balance of the gut microbiota, boost the immune system, and provide other benefits such as reducing inflammation, lowering cholesterol and triglyceride levels, and

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protecting against digestive disorders such as constipation and inflammatory bowel syndrome. However, it is important to pay attention to the right dosage in taking prebiotics for optimal benefits.

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