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# Prebiotic-Enriched Foods: A promising functional food category

**Ayushi Patel, Sreeja V, Kiran S and Masi Imdadhusain Abidali**
Dairy Microbiology Department, SMC College of Dairy Science
Kamdhenu University, Anand, Gujarat
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***Abstract***

The global rise in demand for functional foods reflects growing consumer interest in health-enhancing dietary options. Prebiotics are non-digestible food ingredients that enhance host health by selectively stimulating beneficial gut bacteria. Often termed soluble fiber, prebiotics offer biological effects, reduce caloric content, diminish cariogenic properties, and enhance food texture. The incorporation of prebiotics into different food matrices leads to beneficial modifications in their physicochemical, rheological, sensory, and functional properties. The extent of these changes varies based on the type of the foods and the specific prebiotic used.

**Keywords**: Health benefits, gut microbiota, inulin, probiotics, food ingredient, oligosaccharide

## Introduction

The demand for functional foods—products that offer health benefits beyond basic nutrition—is rising as more consumers prioritize their well-being. Among these, prebiotic enriched foods are gaining momentum owing to their proposed health benefits. The concept of prebiotics was initially proposed by Glenn Gibson and Marcel Roberfroid in 1995, defining prebiotics as non-digestible food components that selectively enhance the growth and activity of specific colon bacteria, thus improving host health. The International Scientific Association of Probiotics and Prebiotics (ISAPP, 2013) later refined this definition, describing prebiotics as substrates selectively utilized by host microorganisms to confer health benefits (Gibson *et al.*, 2017). Prebiotics offer advantages over probiotics due to their stability, resistance to processing, and positive impact on food texture and flavor. Additionally, they withstand acids, proteases, and bile salts in the gastrointestinal tract, enhancing their efficacy.

## Criteria for classifying a food ingredient as a prebiotic

According to Gibson *et al*. (2017), a food product is classified as a prebiotic if it meets several key criteria. First, it must resist gastric acidity, absorption in the gastrointestinal tract, and digestion by mammalian enzymes, allowing it to endure the harsh conditions of the stomach without being broken down by the host's own enzymes. Second, a prebiotic should be fermentable by gut bacteria, leading to the production of beneficial compounds. Lastly, it must selectively promote the growth and activity of beneficial gut microbiota, thereby supporting the host's health and well-being. The ability to specifically stimulate beneficial gut bacteria is a crucial aspect of its function.

## Types of Prebiotics

Beyond carbohydrates, non-carbohydrate prebiotics like polyphenols—found in tea, coffee, red wine, and fruits—enhance gut microbiota composition. Resistant starch also functions as a prebiotic by reaching the colon intact, serving as a substrate for beneficial bacteria. Additionally, certain peptides and amino acids may support specific gut microbes. Synthetic prebiotics are being developed for more targeted microbiota modulation, offering potential advantages over natural sources (Bedu-Ferrari et al., 2022). Expanding research continues to uncover new prebiotic compounds, broadening their applications for gut health and overall well-being. Figure 1 depicts a broad classification of prebiotics.

| | |
|---|---|
| **Established** | • Inulin, FOS, GOS, Lactulose |
| **Potential** | • ***Oligosaccharides*** -(XOS, RFO, IMO, Isomaltulose<br>***Polyols*** -(Mannitol, Lactitol, Xylitol)<br>***Non-starch polysaccharides*** **-**(Pectin, Lignin, Beta-glucan)<br>***Starch polysaccharides*** - (resistant starch) |
| **Emerging** | • Carotenoids, Phenolic compounds, Vitamins, PUFAs |

Fig 1. Broad classifications of prebiotics (Sourced from Rosa *et al*, 2021)

FOS=Fructooligosaccharides, GOS=Galacto-oligosaccharides, XOS=xylo-oligosaccharides, IMO=Maltooligosaccharides, RFO= Raffinose family oligosaccharides

## Prebiotics approved by FSSAI for incorporation into foods

The Food Safety and Standards Authority of India (FSSAI) has approved various prebiotics, including polydextrose, isomalto-oligosaccharides, XOS, inulin, lactulose, resistant dextrin, and GOS. Certain sugar alcohols such as lactitol, sorbitol, and maltitol are also included. FSSAI sets a



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thescienceworldmagazine@gmail.com
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recommended daily intake of up to 40g for adults, with new prebiotics being evaluated for inclusion based on scientific evidence (FSSAI, 2022).

**Health Benefits of Prebiotics**

Prebiotics selectively stimulate beneficial gut bacteria, promoting host health. By stimulating the intestinal microbiota, prebiotics influence fermentation activity and short-chain fatty acid levels, contributing to health benefits. Studies have explored their effects on bacterial growth and acidification, cell line adherence, antimicrobial properties, gastric tolerance, adhesion abilities (Parhi et al., 2021), and biofunctional properties. Claimed health benefits of selected prebiotics are depicted in Table 1.

**Table 2. Prebiotics and its claimed human health benefits**

| Prebiotic | Disease condition | Study model | Claimed health benefits |
|---|---|---|---|
| Inulin | Ulcerative colitis (UC) management | Randomised, double-blind, crossover placebo-controlled study with 24 patients | Reduced the endoscopic and histological pouchitis disease index score, lowered gut pH, and reduced secondary bile acid and *Bacteroides fragilis* in faecal samples<br><br>Increased gut Bifidobacteria |
| Lactulose | Crohn's disease (CD) and UC | Consumption of 20 g lactulose per day | Reduction in disease symptoms |
| Oligofructose (OF) | Antibiotic-Associated Diarrhoea | Daily ingestion of 12 g of OF in 142 patients with *Clostridium difficile*-induced diarrhoea | Reduced episodes of diarrhoea |
| Inulin | Traveller's diarrhoea | 244 healthy subjects travelling to high- or medium-risk destinations for traveller's diarrhoea received either 10 g of inulin or placebo for 2 weeks before travelling and then for the 2 weeks they were away | Lower prevalence of diarrhoea in the prebiotic group, and less severe attacks of diarrhoea |
| OF and inulin mixture together with *Lactobacillus rhamnosus* GG and *Bifidobacterium lactis* Bb-12 | Colon cancer | 12 weeks double blind placebo-controlled trial in patients with cancer and polypectomised individuals. | Significant reduction in colorectal cell proliferation and genotoxicity Increased intestinal barrier function. |
| Inulin | | Rat study | Inhibition against the formation of aberrant crypt foci (ACF), a biomarker for colon cancer |
| Inulin and *L. acidophilus* | | Rat study | Pronounced reduction of ACF in the distal parts of the colon |
| Fructans | Calcium absorption and bone health | Rat studies | Enhancement of calcium absorption |
| | | Human studies | |

| | | | |
|---|---|---|---|
| Inulin-type fructans | | 100 young adolescents received 8g/day of short- and long-chain inulin fructans for a year | Significant increase in calcium absorption and greater bone mineral density |
| Oligofructose | Magnesium absorption | post-menopausal women | Increased Magnesium absorption |
| | Relief from constipation | | |
| Oligofructose | Obesity | 48 healthy adults with a body mass index (in kg/m2) >25 | Reduction in body weight of 1.03-0.43 kg with Oligofructose supplementation |

Sourced from: Ashwini et al, 2019 and others

## Conclusion

With ongoing research, prebiotics are increasingly recognized not just for their nutritional value but also as essential components of functional foods designed to enhance gut health, immunity, and overall well-being. The selection of a prebiotic for a food product depends on its intended purpose and the specific food matrix, as different prebiotics interact uniquely with foods, leading to various technological modifications. Similarly, the health benefits of prebiotics vary depending on the specific type consumed. Therefore, understanding prebiotic-enriched functional foods, their role, and their associated benefits is essential.

## References

Ashwini, A., Ramya, H.N., Ramkumar, C., Kakarl, R.R., Raghavendra, V., Kulkarni, V., Abinaya, S. N., Anjanapura, V. R., 2019. Reactive mechanism and the applications of bioactive prebiotics for human health: Review. Journal of Microbiological Methods 159 (2019) 128–137. https://doi.org/10.1016/j.mimet.2019.02.019

Bedu-Ferrari, C., Biscarrat, P., Langella, P., & Cherbuy, C. (2022). Prebiotics and the human gut microbiota: From breakdown mechanisms to the impact on metabolic health. *Nutrients*, 14(10), 2096. https://doi.org/10.3390/nu14102096

Ferreira VC · Tiago Linhares Cruz Tabosa Barroso1 Rafael Gabriel da Rosa1 · Luciana de Siqueira Oliveira (2023). An overview of prebiotics and their applications in the food industry. European Food Research and Technology (2023) 249:2957–2976. https://doi.org/10.1007/s00217-023-04341-7

Gibson, G. R., Hutkins, R., Sanders, M. E., Prescott, S. L., Reimer, R. A., Salminen, S. J., ... & Reid, G. (2017). Expert consensus document: The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of prebiotics. *Nature reviews Gastroenterology & hepatology*, 14(8), 491-502. https://doi.org/10.1038/nrgastro.2017.75

International Scientific Association for Probiotics and Prebiotics. (2013) https://isappscience.org/for-scientists/resources/probiotics/

Parhi, P., Song, K. P., & Choo, W. S. (2021). Viability, storage stabilityand *in vitro* gastrointestinal tolerance of *Lactiplantibacillus plantarum* Grown in model sugar systems with inulin and fructooligosaccharide supplementation. *Fermentation*, 7(4), 259. https://doi.org/10.3390/fermentation7040259

Rosaa M C, Carmoa M R S, Balthazar, C F (2021). Dairy products with prebiotics: An overview of the health benefits, technological and sensory properties. International Dairy Journal 117 (2021) 105009.