

Probiotics and prebiotics

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Abstract

Probiotics and prebiotics are central to supporting a healthy gut microbiome. Probiotics are live microorganisms that confer health benefits when consumed in adequate amounts, while prebiotics are non-digestible fibres that serve as nourishment for beneficial gut bacteria. Together, they can influence digestion, immunity, metabolism, and even mental health. However, the clinical effectiveness of probiotics depends not only on strain and dose, but also on survival during storage and passage through the upper gastrointestinal tract. Evidence shows that many products fail to deliver the promised viable organisms to the intestine, with substantial loss occurring before purchase and upon exposure to the harsh conditions in the stomach. This article reviews the roles and sources of probiotics and prebiotics, their complementary functions, the impact of antibiotics on gut flora, and the critical importance of delivery mechanisms in ensuring probiotic efficacy.

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Introduction

The gut microbiome is now recognised as a dynamic ecosystem influencing digestion, nutrient absorption, immunity, and metabolic health. Emerging research also links gut bacteria to mood and cognition through the gut–brain axis.¹ Maintaining this balance is particularly important in contexts where antibiotics are widely used and where both infectious and chronic diseases are prevalent.^{2,3}

Two tools frequently discussed in this regard are **probiotics** and **prebiotics**. Though often paired, they differ fundamentally: probiotics are live microorganisms providing direct health benefits, while prebiotics are fibres that selectively stimulate the growth of these beneficial microbes. Used together, they can restore and maintain microbial balance in the gut, particularly after disruptive events such as antibiotic therapy.⁴

Probiotics: definition, uses, and sources

Probiotics are defined as “live microorganisms which, when administered in adequate amounts, confer a health benefit on the host”.⁴ Commonly used Genus include *Lactobacillus*, *Bifidobacterium*, and *Saccharomyces boulardii*.³

Clinical evidence supports several applications of probiotics:

- **Antibiotic-associated diarrhoea (AAD):** Certain species, particularly *Lactobacillus rhamnosus* GG and *S. boulardii*, significantly reduce the incidence of diarrhoea linked to antibiotics.⁵
- **Clostridioides difficile infection:** Probiotics can lower recurrence rates when used alongside standard therapy.⁵
- **Irritable bowel syndrome (IBS):** Selected strains help reduce bloating, abdominal pain, and irregular stool patterns.¹

- *Lactobacillus Acidophilus* NCFM reduces gut/abdominal pain and overall IBS symptoms (bloating, irregular stool patterns)^{6,7}
- *Lactobacillus Paracasei* LPC-37 reduces stress triggers and improves gut-brain axis⁸
- *Bifidobacterium Lactis* HN019 reduces symptoms of constipation and improve WGTT (whole gut transit time)^{9,10}
- **Immune support:** By stabilising gut microbial diversity, probiotics contribute to immune resilience.³
- **Gut–brain axis:** Emerging data suggest some probiotics may improve mood and reduce anxiety symptoms.¹

Dietary sources include yoghurt, fermented milk (such as maas), kefir, sauerkraut, kimchi, miso, and tempeh. Supplements in capsule, powder, or sachet form are widely available but vary in quality and viability.

Prebiotics: definition, uses, and sources

Prebiotics are non-digestible food components, often fibres such as inulin, fructo-oligosaccharides (FOS), and galacto-oligosaccharides (GOS), that selectively stimulate the growth of beneficial gut bacteria.³

Their clinical benefits include:

- Supporting probiotic colonisation and persistence.³
- Improving stool bulk and regularity.³
- Enhancing absorption of minerals like calcium and magnesium.
- Reducing cholesterol levels and potentially lowering colorectal cancer risk.^{1,4}

Prebiotics occur naturally in onions, garlic, leeks, bananas, apples, asparagus, oats, legumes, and chicory root. Increasing dietary intake gradually is advised, as sudden increases may cause bloating or gas. Synbiotic products combine probiotics and

Product/Brand Name	Probiotic Strain	Prebiotic Component	CFU per dose	Recommended Dosage	Safety Notes
Probiotec					
Probiotec	Lactobacillus acidophilus La14	FOS 10 mg (inner) + FOS 55 mg (outer)	15 billion CFU per capsule	1 capsule daily; or as advised by HCP	Avoid if allergic or sensitive or if immunocompromised; Consult if pregnant/nursing or on medication. Not suitable for children <6 years of age.
Probiotec Intrinsic Bowel Support	L. acidophilus NCFM; L. rhamnosus GG (ATCC 53103); L. plantarum Lp115; L. paracasei Lpc37; B. lactis BI04; B. lactis HN019; B. lactis BI07; S. thermophilus St21	None	20 billion CFU total per capsule	1 capsule daily; or as directed by HCP	
Probiotec Fibre+	None (prebiotic formula)	Fibersol2 5 g; Lglutamine 3 g; enzymes (amylase, protease, invertase, diastase, lipase, cellulase, lactase)	N/A (no CFU)	Dissolve 1–2 sachets daily in noncarbonated liquid/soft food	

FOS: Fructo-oligosaccharides

prebiotics, aiming to improve both survival and effectiveness of the probiotic.⁴

Complementary roles

Although distinct in nature, probiotics and prebiotics act synergistically. Probiotics replenish beneficial bacteria in the gut, while prebiotics provide the nutrients these organisms need to thrive. When combined, synbiotics may enhance colonisation and long-term stability of the gut microbiome.^{2,4}

Antibiotics and the microbiome

Antibiotics remain essential in treating bacterial infections but also cause collateral damage to the gut microbiome. They can eliminate beneficial bacteria along with pathogens, leading to diarrhoea, discomfort, reduced immune resilience, and increased susceptibility to opportunistic infections such as *C. difficile*.⁴

Probiotics are most effective when taken during antibiotic therapy (at least two to three hours apart from the antibiotic dose if not protected by technologies such as the DuoCap capsule) and continued for one to two weeks afterwards to restore microbial balance.⁴ Prebiotics support this recovery by providing a favourable growth environment for beneficial organisms.

Probiotic survival: why delivery matters

While evidence supports the clinical potential of probiotics, their effectiveness hinges on a crucial factor: whether enough live organisms reach the intestine intact. Two major failure points undermine this goal:

Pre-purchase viability loss

Probiotic organisms are sensitive to environmental stressors such as heat, oxygen, moisture, and light. Many strains are anaerobic

or microaerophilic and therefore particularly prone to oxidative damage. Liquids tend to be the least stable formulation, while glass packaging provides better protection against oxygen and light than oxygen-permeable plastics. Field studies estimate that poor storage can lead to up to a 50% loss of viable organisms before purchase.^{11,12}

In-body loss during digestion

Once ingested, probiotics must survive gastric acid (pH 1–2.5) and exposure to bile and pancreatic enzymes. Studies show that only around 10–25% of unprotected probiotics survive stomach transit, with further attrition occurring in the small intestine.

Label discrepancies and dosing issues

A further concern is the accuracy of product labelling. Audits have reported that some commercial probiotics contain up to 50% fewer viable organisms than stated on the label, with as many as 11% of products showing no viable microorganisms at all. Clinical efficacy is dose-dependent, with approximately 10¹⁰ colony forming units (CFU) per day commonly cited as the adult target for positive outcomes (condition-specific). Without reliable labelling and delivery systems, patients may not achieve therapeutic benefit.^{11,12,13}

Delivery technologies and solutions

Given these challenges, effective probiotic delivery requires systems that:

- 1. Maintain viability during manufacturing and storage.
- 2. Protect organisms from gastric acid and digestive enzymes.
- 3. Enable targeted release in the intestine.

Approaches to achieve this include microencapsulation, pH-sensitive coatings, and controlled-release technologies.^{14,15,16}

Controlled-release systems

Technologies such as DuoCap™ have been designed to protect probiotics from gastric destruction and ensure targeted release in the intestine. By addressing pre-purchase die-off, gastric attrition, and label-content inconsistencies, such delivery mechanisms significantly improve the likelihood that an effective dose reaches the gut.¹⁵⁻¹⁷

Clinical relevance

The health effects of probiotics are both strain-specific and dose-dependent, but these benefits can only be realised if sufficient viable organisms reach the intestine. Delivery mechanisms therefore play a decisive role. Without protection, even clinically proven strains may fail to exert their intended effects due to poor survival during storage or gastric passage.^{12,13}

Protected delivery systems that ensure accurate CFU counts at the end of shelf-life, and targeted release in the intestine, maximise the chance of achieving consistent, evidence-based outcomes. In practice, this means that product choice should be guided not only by strain and indication, but also by whether the formulation safeguards viability until the point of action.^{11,16,19}

Conclusion

Probiotics and prebiotics together offer powerful tools to maintain gut health, particularly during and after antibiotic therapy. Probiotics replenish beneficial microorganisms, while prebiotics create the conditions for their survival and activity. However, evidence highlights that viability loss before purchase, destruction in the stomach, and inaccurate labelling often compromise clinical effectiveness.

Advances in delivery technology—such as targeted, controlled-release capsules—address these shortcomings by protecting probiotics from environmental and gastric stresses and ensuring release at the intended site of action. For those recommending or selecting probiotic products, considering not only strain and dose but also formulation and delivery system is crucial. By combining dietary strategies with evidence-based, protected formulations,

individuals can achieve the full potential of probiotics and prebiotics for digestive, immune, and overall health.

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