Synbiotic support during and after antibiotics: Why probiotics plus prebiotics – and delivery – matter

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Abstract

The gut microbiome is integral to gastrointestinal and systemic health. Antibiotic therapy is a major driver of gut dysbiosis, characterised by loss of microbial diversity, depletion of beneficial bacteria and expansion of opportunistic and antimicrobial-resistant pathogens. Probiotics reduce antibiotic-associated diarrhoea and support microbiome recovery, while prebiotics selectively support beneficial bacterial growth. When combined as a synbiotic, probiotics and prebiotics provide complementary and synergistic support for gut recovery during and after antibiotic therapy. This article discusses the rationale for synbiotic use, strain-specific probiotic evidence, immune effects, and the importance of targeted delivery for clinical efficacy.

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Introduction

The human gastrointestinal tract harbours a complex microbial ecosystem containing approximately 40 trillion bacterial cells across more than 1 000 species.[1-3] This microbiome contributes to digestion, immune regulation, epithelial integrity and metabolic homeostasis.[2,4]

Disruption of this ecosystem is associated with gastrointestinal disorders such as inflammatory bowel disease and irritable bowel syndrome, as well as systemic conditions including obesity, type 2 diabetes, atopy and neurodegenerative disease.[2,4,5]

Antibiotic exposure can disrupt the microbial balance of the gut microbiome, reducing microbial diversity, facilitating pathogen overgrowth and the emergence of antibiotic-resistant microbes.[4,6] Supporting microbiome recovery during and after antibiotic therapy through synbiotic supplementation (combining probiotics with prebiotics) may help to restore the microbial balance disrupted by antibiotics.[6,7]

Insights into dysbiosis

A stable gut microbiome is sustained by dominant gut phyla such as Firmicutes and Bacteroidetes, which play a critical role in immune modulation, short-chain fatty acid (SCFA) production and maintenance of the intestinal barrier.[7] Many gut microbial species have the potential to cause disease.[8] For example, species from the Enterobacteriaceae family, such as *Escherichia coli* are opportunistic pathogens with the potential to cause severe infections.[8]

Dysbiosis is characterised by loss of beneficial microbes, reduced microbial diversity and overgrowth of potential pathogens.[7] Dysbiosis may be the result of multifactorial disturbances of gut homeostasis, including antibiotic exposure.[7]

Broad-spectrum agents including aminopenicillins (± clavulanate), cephalosporins, clindamycin and fluoroquinolones often drive dysbiosis.[4,6,7] This disruption in the gut microbiome favours overgrowth of opportunistic species, increases the risk of antibiotic-associated diarrhoea (AAD) and *Clostridioides difficile* infection and is associated with longer-term metabolic and inflammatory sequelae.[3,6,7]

Recovery of the gut microbiome is influenced by antibiotic spectrum, dose and duration of treatment and may take weeks to months in some cases.[4,6,7] During this recovery phase, synbiotic interventions may support restoration of the gut microbiome balance disrupted by antibiotic therapy.[6,7]

Probiotics, prebiotics and synbiotics: the concepts

Probiotics

Probiotics are live microorganisms that, when administered in adequate amounts, confer a health benefit on the host.[3] Their effects include pathogen interaction, enhancement of epithelial barrier function, immune modulation and production of beneficial metabolites such as SCFAs.[3,7]

Prebiotics

Prebiotics are selectively fermented, non-digestible substrates that stimulate the growth or activity of beneficial gut bacteria, leading to improved host health.[3] Common examples include fructooligosaccharides (FOS), inulin and galactooligosaccharides (GOS).[3]

Synbiotics

Synbiotics comprise live microorganisms and substrates, i.e., probiotics and prebiotics to provide complementary or synergistic effects to the probiotic organism.[3,9] The principal purpose of a

synbiotic combination is the improvement of the survival of probiotic microorganisms in the gastrointestinal tract.[9]

The role of probiotics in the management of gut dysbiosis

Clinical evidence supports probiotic use alongside antibiotics to reduce gastrointestinal side-effects such as diarrhoea.[6]

- Witsell et al. demonstrated that *Lactobacillus acidophilus* administered with amoxicillin/clavulanate significantly reduced gastrointestinal complaints and yeast superinfections compared with antibiotic therapy alone.[10]
- Forssten et al. showed that *L. acidophilus* administered as a multistrain formulation during antibiotic treatment can persist in the gut and contribute to microbiome recovery following antibiotic treatment cessation.[11]
- Meta-analyses confirm that probiotics, including *L. acidophilus*, *L. rhamnosus*, *L. casei*, *Bifidobacterium* spp. and *Saccharomyces boulardii*, reduce the risk of antibiotic-associated diarrhoea across age groups, with higher doses associated with greater efficacy.[3,6]

Immune modulatory mechanisms of probiotic bacteria

Probiotics mediate the modulation of both innate and adaptive immune responses in the intestine by stimulating:[12]

- Production of various cytokines and chemokines from dendritic cells, lymphocytes, macrophages, mast cells, granulocytes, and intestinal epithelial cells
- Immunoglobulin A (IgA)-producing cells and consequent IgA secretion

Probiotics can therefore improve the host immune system and induce important beneficial effects, allowing prevention and/or management of immune/inflammatory-related diseases, including diarrhoea.[12]

Probiotic survival: why delivery matters

Probiotic efficacy depends on strain selection, dose, viability and delivery.[13] Probiotic organisms are sensitive to heat, oxygen, moisture and gastric acidity, with poor storage or formulation leading to substantial colony-forming units (CFU) losses before intestinal delivery.[13,14]

Encapsulation technologies aim to protect probiotics during storage and gastrointestinal transit.[14] DUOCAP™ capsule-in-capsule technology enables staged release, with the outer capsule dissolving in the stomach and the inner, acid-resistant capsule releasing the probiotic in the intestine.[15,16]

A word on Probitec

Probitec® is a synbiotic formulation delivering 15 billion CFUs of *Lactobacillus acidophilus* La-14 per capsule, combined with fructooligosaccharides (FOS) as a prebiotic substrate to support the resident beneficial microbes in the gut.[3,16]

Formulated using DUOCAP™ technology, Probitec® protects probiotic viability, ensures targeted intestinal release and supports microbial recovery during and after antibiotic therapy.[16,17] The product maintains labelled CFU potency over its shelf life and can be taken with or without food, including alongside antibiotics.[16]

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