

Probiotics and Prebiotics: Practical Considerations

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Objectives

1. Define probiotic and prebiotics
2. Discuss clinical situations in which prebiotics and probiotics are found to be useful based on evidence.

Table 1: Probiotic Criteria

- Strain identification
- Human origin
- Live microorganism
- Viable
- Safe for human consumption
- Survive proximal GI tract
- Reach distal intestine and colon
- Function/adhere to gut epithelial tissue
- Colonize distal gut impacting microbiome composition
- Scientifically proven health benefits

Table 2: Probiotic Proposed Mechanisms of Action

Colonization resistance

- Competitive exclusion

Intestinal barrier function maintenance

- Maintain tight junctions (ZO-1, claudin1)
- Reduce macromolecular permeability and bacterial translocation

Enhance gut microbiome pattern

- Enhance ratio of commensal bacteria

Modulation of inflammatory and immunoregulatory signaling

- NF- κ B
- IL-10
- Toll-like receptor(s)

Innate/Adaptive immune modulation

- Increase mucin regulatory genes and mucin production
- Defensin production
- Engagement with dendritic cells
- IgA, IgG, IgM production

Metabolic effects

- Nutrient metabolism
- Bacteriocins
- Decrease luminal pH
- Quorum sensing

Table 3: Some Commercially Available Probiotics

Strain	Initial Product	Supplier	Year Introduced
<i>L. casei</i> strain Shirota	Yakult	Yakult	1935
<i>S. thermophilus</i> <i>L. bulgaricus</i> <i>L. acidophilus</i> <i>Bifidus</i>	Yogurt	Stoneyfield	1973
<i>B. longum</i> BBS36	Bifidus Milk	Moringa Milk Products	1977
<i>B. breve</i> strain Yakult	Mil-Mil (Bifiene)	Yakult	1978
<i>B. lactis</i> BB-12	Yogurt	Chr. Hansen	1988
<i>L. rhamnosus</i> GG	Gefilus	Valio	1990
<i>L. casei</i> DN-114-001 (<i>L. casei</i> Immunitas)	Actimel (DanActive)	Danone	1994
<i>L. johnsonii</i> La-1	LC1	Nestle	1994
<i>L. plantarum</i> 299v	ProViva	Probi	1994
<i>B. animalis</i> DN-173-010 (<i>Bifidus regularis</i>)	BIO (Activia)	Danone	1995
<i>L. gasseri</i> LG21	LG21	Meiji Milk Products	2000
<i>B. lactis</i> HN-019	Supplement	Danisco	2001
<i>L. casei</i> KW2110	Yogurt	Kirin Holdings	2003
<i>L. casei</i> F19	Cultura	Arla Foods	2004
<i>E. Coli</i> Nissle 1917	Mutaflor	Medical Futures	

<i>L. casei</i> , <i>L. plantarum</i> , <i>L. acidophilus</i> , <i>L. delbrueckii</i> subsp <i>vulgaricus</i> , <i>B. longum</i> , <i>B. breve</i> , <i>B. infantis</i> , <i>S. salivarius</i> subsp <i>thermophilus</i>	VSL#3	Sigma-Tau Pharmaceuticals	
<i>Bifidobacterium infantis</i> 35624	Align	Proctor & Gamble	

Note: Google search: 12,40,000 hits

Table 4: Prebiotic Characteristics (104)

Three Necessary Criteria of Ingredient	<ol style="list-style-type: none"> 1. Must be resistant to gastric acidity, to hydrolysis by mammalian enzymes, and to gastrointestinal absorption 2. Must be fermented in the GI tract by gut microbiota 3. Must be selective in the stimulation of the gut microbiota growth and/or activity that contribute to health and well-being
Not available to all bacterial species in gut microbiome	Lactobacilli and Bifidobacteria considered indicator organisms
Simple, naturally occurring or synthetic sugars	<ul style="list-style-type: none"> - Inulin (chicory, leeks, onion, garlic, artichoke, asparagus: DP 10-60) - Inulin-type fructans (oligofructose or FOS): $DP_{max} < 10$ <ul style="list-style-type: none"> • via partial hydrolysis of inulin or synthetically from monomers - Trans-galactooligosaccharides (GOS) <ul style="list-style-type: none"> • Enzymatic synthesis based on lactose

	- Lactulose
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Other Resources:

International Scientific Association for Prebiotics and Probiotics

<http://www.isapp.net/>

<http://nccam.nih.gov/health/probiotics/>

<http://www.medicinenet.com/probiotics/page3.htm>