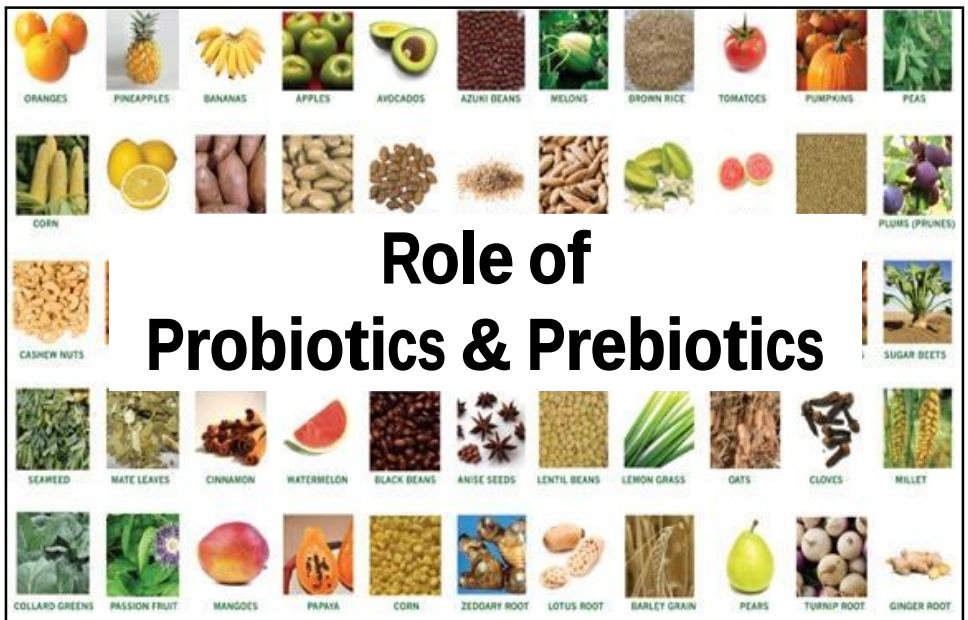



# Role of Probiotics & Prebiotics

Minidian Fasitasari

Dept. of Nutrition, UNISSULA

## Definitions

- Probiotics vs antibiotics
- Prebiotics vs postbiotics
- Synbiotics

- Why we should be taking probiotics.flv

## Prebiotics

- Greek language: “before life”
- Non-digestible food additives, often fructo-oligosaccharides (FOS), beneficially affect the host by selectively stimulating the growth &/or activity of limited number of bacteria in the colon

## Prebiotics

- Non-digestible food supplements or ingredients
- Not absorbed or degraded
- Alter the balance of intestinal flora and by acting as substrates stimulate the growth of beneficial bacteria (i.e., Lactobacillus and Bifidobacteria)

## Prebiotics, 3 criteria:

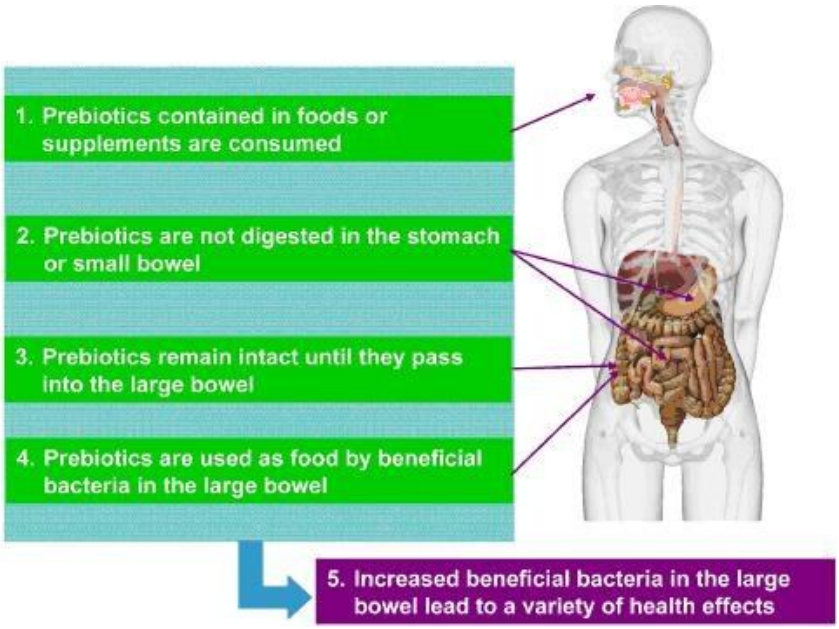
- **Must not be hydrolyzed nor absorbed in the upper gastrointestinal tract**
- **Must be a substrate for growth or activity of one or a limited number of beneficial colonic bacteria**
- **Must therefore be able to alter the colonic microflora towards a healthier composition and to induce luminal or systemic effects which are beneficial to the health of the host**

# Prebiotics

- Fructooligosaccharide (FOS)
- Galactooligosaccharide (GOS) – in human milk
- Xylooligosaccharide
- Inulin
- Fiber
- Lactulose (a synthetic)
- & others

# Prebiotics

- Found in: Breastmilk, Jerusalem artichoke, chicory root, raw dandelion greens, leeks, onions, garlic, asparagus, whole grains, beans, banana




# Probiotics

- Greek language: "for life" (vs. antibiotics)
- Non-pathogenic live microbial food supplements
- Organisms that, when administered in adequate amounts, exert a positive influence on the health of the host animal
- Live organisms that benefit the host animal by improving intestinal microbial balance
- Usually administered in yogurt or capsules

# The Digestive System

**Normal intestinal flora contains100 trillion organisms from 400 different species**

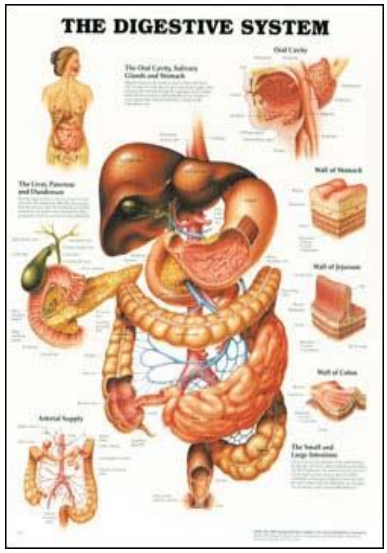
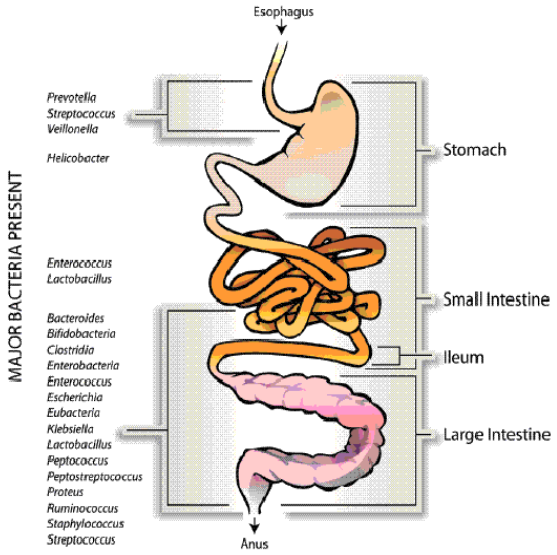



Figure A. Distribution of Nonpathogenic Microorganisms in Healthy Humans. Many of These Bacteria Possess Enzymes That Can Cleave ß-glycosidic Linkages

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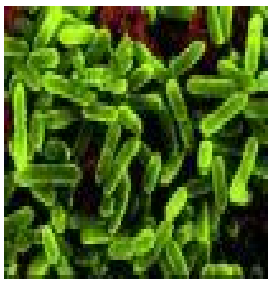
Reprinted with permission of Jane Ramberg. *GlycoScience & Nutrition*. Vol 6, No 6, 2005.

# Probiotics



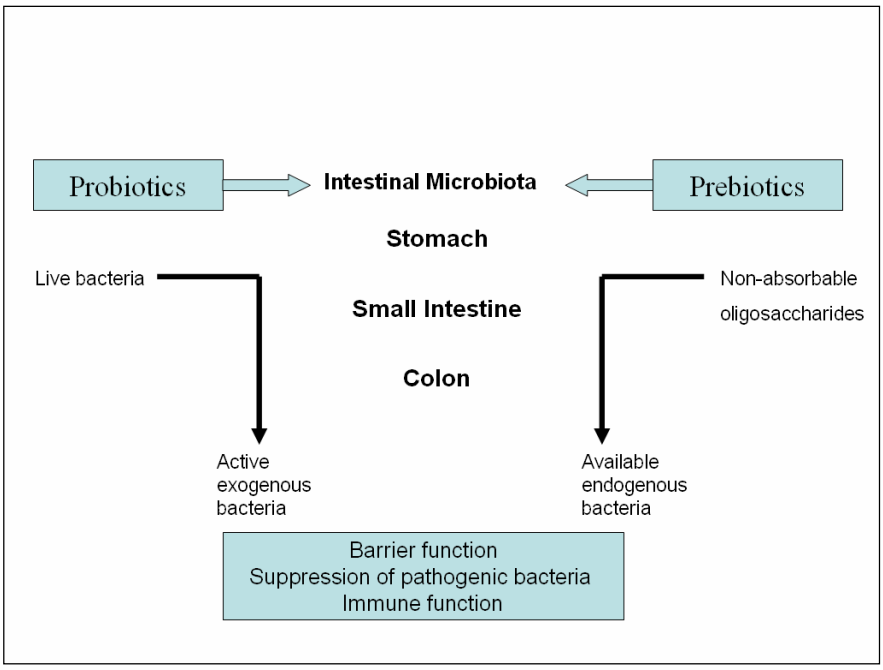
- Lactobacilli – anerobic, gram (+) rods
  - casei
  - plantarum
  - acidophilus
  - reuteri
- Bifidobacteria – anerobic, gram (+) rods
- VSL #3 (8 separate organisms: 3 Bifidobacteria, 1 Streptococcus, 4 Lactobacilli)
- Enterococcus
- Streptococcus salivarius
- Saccharomyces

# Probiotics

- Monostrain or multispecies?
- Animation Multispecies and monostrain probiotics.flv

# Synbiotics

- A probiotic organism in combination with its prebiotic food
- Providing both the organism and substrate at the time of ingestion may offer improved chance of survival in GI tract
- → Products containing both:
  - Prebiotics
  - Probiotics



## Probiotics: Mechanism of Action

- Competitive inhibition
- Barrier protection
- Immune effects
- Anti-inflammatory effects
- Production of various substances (enzymes, SCFA, bacteriocidal agents)
- Ability to alter local pH and physiology
- Provides nutrition to colonocytes

## Probiotics: Competitive Inhibition

- Helps to restore the balance of “good” bacteria and “bad” bacteria
- Facilitates the growth of healthy bacteria – i.e., Bifidobacterium and Lactobacillus
- Bifidobacterium infantis inhibits the growth of Salmonella (O’Mahony 2004; Gastro)

## Probiotics & Immune Function

- Mononuclear cells incubated with Lactobacilli produce higher levels of IFN-gamma, TNF-alpha, and IL-1 (MacFarlane & Cummings, BMJ, 1999)
- Bifidobacteria suppressed the pro-inflammatory mediators (TNF-alpha, IFN-gamma, IL-12) in a murine model of IBD (IL-10 knockout) (McCarthy et al, Gut 2003)
- In healthy volunteers, L. rhamnosus increased phagocytic activity and NK tumor cell killing activity (Sheih et al, J Am Coll Nutri 2001)

## Probiotics & Immune Function

- Borruel and colleagues assayed ileal specimens from Crohn's patients (10) and compared to 5 controls (right hemicolectomy for colon cancer)
- Specimens cultured with various bacteria (L. casei, L. bulgaricus, L. crispatus)
- CD4 levels and TNF-alpha levels reduced in Crohn's explants but not in normal volunteers
- Impression: probiotics interact with immunocompetent cells to modulate the production of pro-inflammatory cytokines from ileal tissue in Crohn's patients (Borruel Gut 2002)

## Probiotics: Production of Other Substances

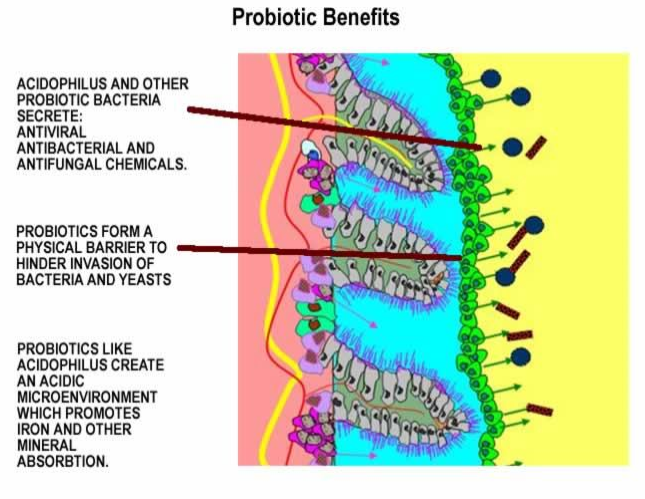
- Intestinal bacteria play a key role in the production of short-chain fatty acids (SCFA)
- Butyric acid is the main fuel for colonocytes
- L. plantarum appeared to increase production of butyric acid in 36 healthy volunteers, leading to reductions in fibrinogen, leptin, and monocyte adhesive properties

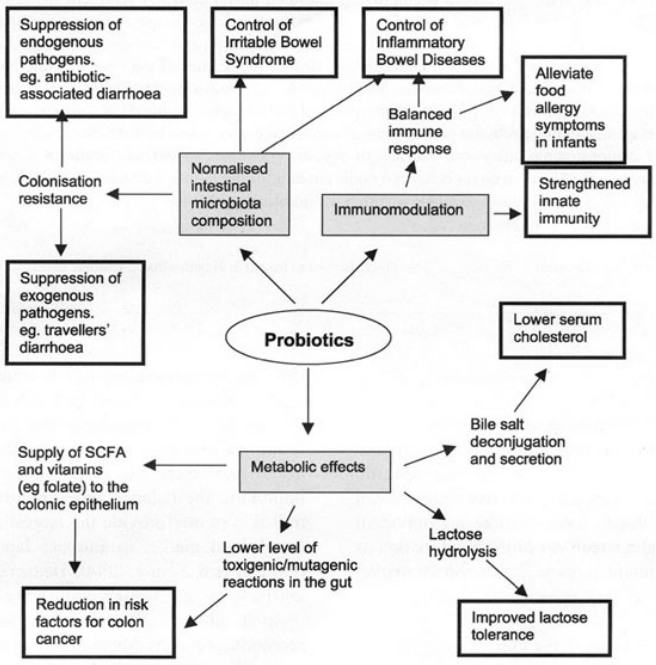
**(Naruszewicz et al Am J Clin Nutr 2002)**

## Probiotics: Impact on Local Physiology

- Example - Antibiotic associated diarrhea
  - Restores resident flora
  - Increases production of SCFA
  - SFCAs are absorbed by diffusion, leading to increased water and Na absorption
  - Stimulates colonocyte proliferation, which may further improve water and Na reabsorption

## Probiotic Benefits




Proposed health benefits stemming from probiotic consumption.

| | |
|---|---|
| Immune stimulation | *Lactobacillus acidophilus, L. casei, L. rhamnosus, L. plantarum, L. delbrueckii, L johnsonii, Bifidobacterium bifidum* |
| Antibiotic-associated diarrhoea | *L. rhamnosus, L. acidophilus. L. bulgaricus, Saccharomyces boulardii, B. longum, Enterococcus faecium* |
| Travellers diarrhoea | *L. rhamnosus, L. acidophilus. L. bulgaricus, B. bifidum, Streptococcus thermophilus, L. johnsonii, S. boulardii* |
| Recurrent *C. difficile* colitis | *L. rhamnosus, S. boulardii* |
| Anti-tumour | *L. acidophilus, L. casei, L. plantarum, L. delbrueckii, L. gasseri, B. longum, B. bifidum, B. adolescentis, B. infantis* |
| Rotavirus diarrhoea | *L. rhamnosus, B. bifidum, S thermophilus* |
| Acute diarrhoea | *B. bifidum, L. bulgaricus, S. thermophilus, L. acidophilus, E. faecium, L. rhamnosus, L. reuteri* |
| Balancing of intestinal microbiota | *L. acidophilus, L. casei, B. bifidum, L. plantarum* |
| Lactose intolerance | *L. bulgaricus, S. thermophilus, L. rhamnosus, L. johnsonii* |
| Lowering faecal enzyme activities | *L. rhamnosus, L. casei, L. gasseri, L. delbrueckii, L. acidophilus* |

# Probiotic Research

## Continued clinical research to study the benefits of probiotics in the areas of :

- **Obesity and Weight Management** (exopolysaccharide producing probiotic strains)
- **Prevention of osteoporosis** (improved bioavailability and absorption of nutrients)
- **Growth development in children** (improved bioavailability and absorption of nutrients)
- **Treating and preventing respiratory infections, specially in children** (boost immune system)
- **Acne treatment and clearer skin** (maintaining a healthy balance of beneficial intestinal microflora)
- **Cancer control** (bind, block or remove carcinogens, activate the host's immune system to antitumorigenesis, inhibit bacteria that directly or indirectly convert procarcinogens to carcinogens)
- **Animal health** (boost immune system, maintain balance of intestinal microflora)

## Potential Adverse Effects of Prebiotics

- **GI Disturbances:**
  - Constipation
  - Abdominal pain
  - Flatulence
  - Bloating


"Madam, you cannot deny that for years now you have been laying the blame for your incessant flatulence on my clients!"

"Probiotics will be to medicine in the 21st century what antibiotics and microbiology were in the 20th"

*(Dr. Michael L. McCann)*

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