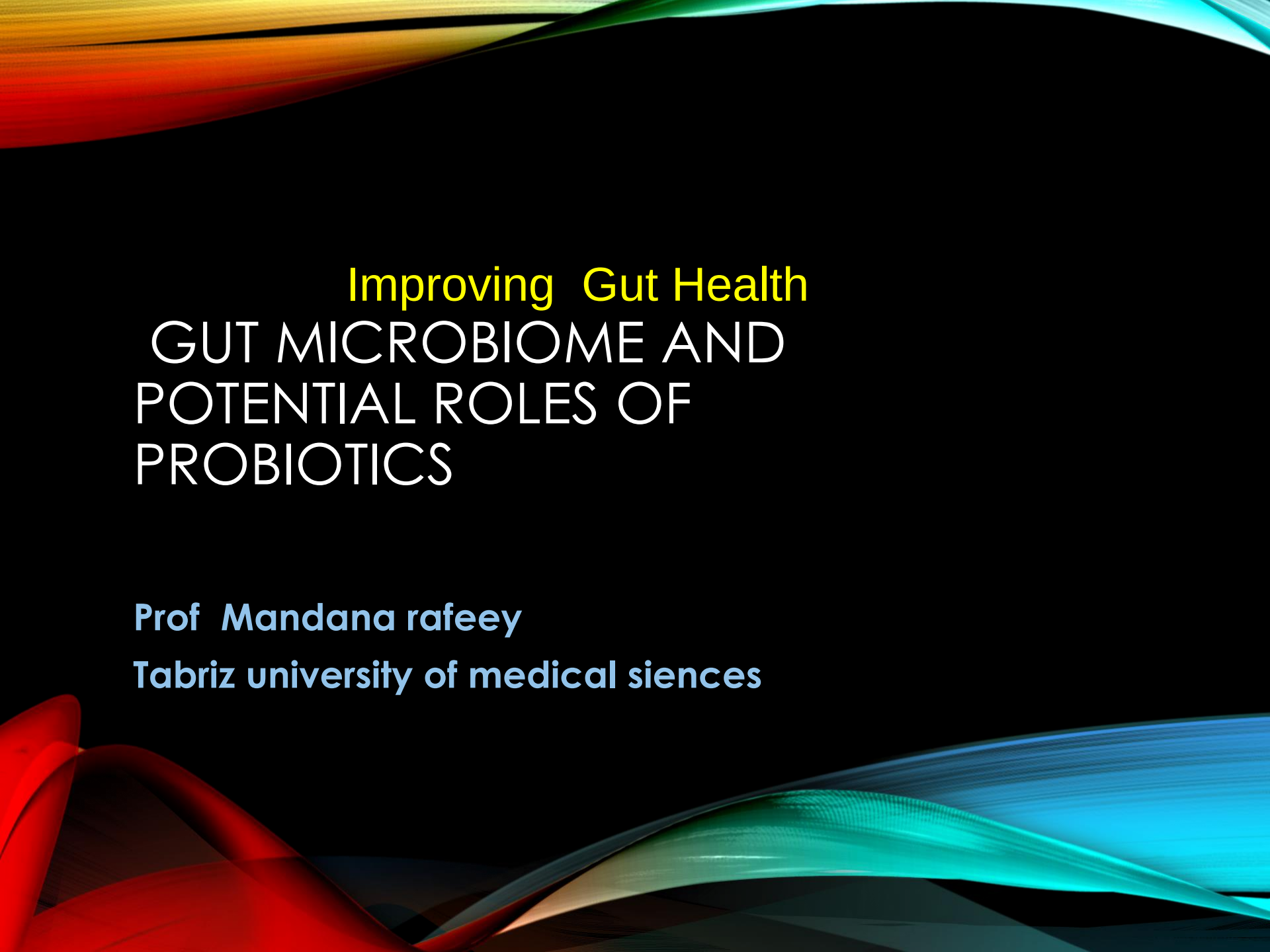




Improving Gut Health GUT MICROBIOME AND POTENTIAL ROLES OF PROBIOTICS

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Probiotics - the Science

Microbial ecosystem and mucosal immunity

- ✓ The intestine contains extensive microbiota (10^{10} bacteria cells), located mainly in the colon
- ✓ The small intestine has a larger bacterial load that consists of facultative anaerobes such as *Lactobacilli*, *Streptococci* and *Enterobacteria* as well as anaerobes such as *Bifidobacterium*, *Bacteroides* and *Clostridium* at levels of 10^4 - 10^8 cells/gm of contents

Colonization of Gut

- **Starts immediately after birth**
 - **Place of birth**
 - **Type of Delivery**
 - **Feeding: Time, Type**
 - **Pre-lacteals vs Exclusive breast feed.**
 - **Premature vs. Full term**
 - **Sick babies**

Colonization of gut

- ✕ **1st Year;: > 200 bacterial species**
- ✕ **Adult : 500-600 bacterial species**
- ✕ **Elderly: 300 Bact. Species**
 - ✚ **Chr. Intestinal disorders**

Table 1 Definitions

Concept	Definition
Probiotics	Live microorganisms that, when administered in adequate amounts, confer a health benefit on the host
Prebiotic	A selectively fermented ingredient that results in specific changes in the composition and/or activity of the gastrointestinal microbiota, thus conferring benefit(s) upon host health
Synbiotics	Products that contain both probiotics and prebiotics, with conferred health benefits

Newborn Microbiota

Initially depends on

- Mother's microbiota maternal vaginal and intestinal flora constitutes the source of bacteria, which colonizes the intestine of new born.
- Mode of deliver
- Birth environment
- Rarely genetic factors
- After infancy probiotics supplied from raw foods; such as lactic acid fermented foods such as yogurt, cheese and probiotic supplements.



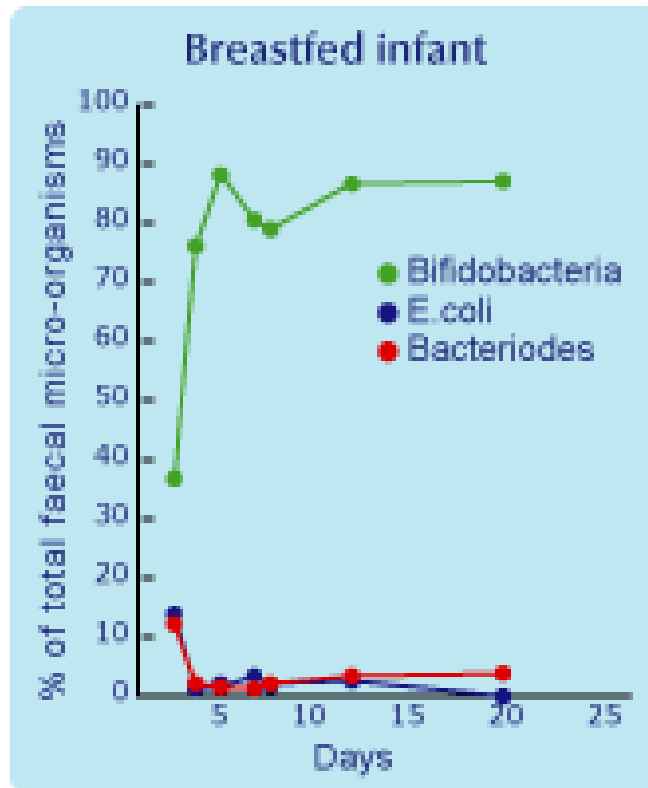
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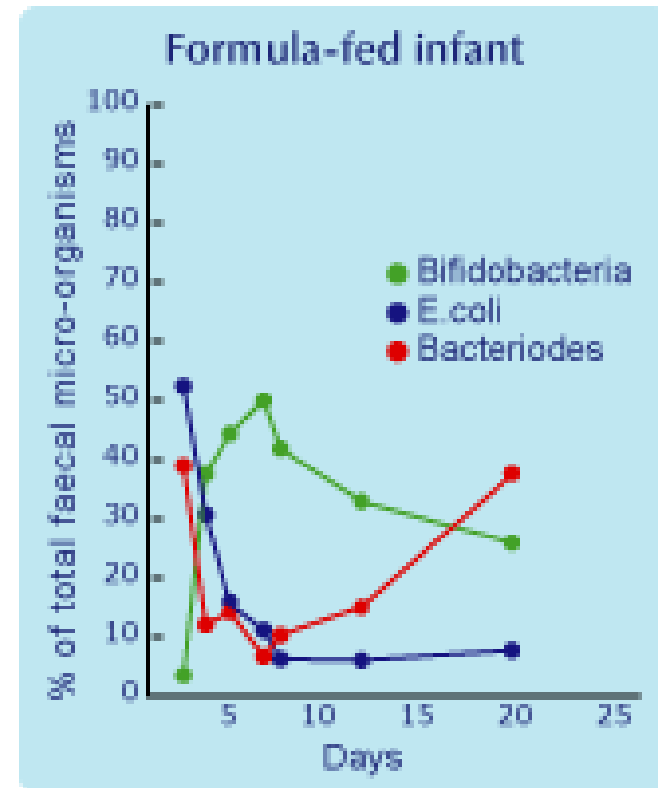
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Gut Flora in Breast Fed vs Formula Fed Babies



In breastfed babies there are high levels of friendly bacteria



In contrast, babies fed infant formulas without prebiotics have lower levels of friendly bacteria

Factors affecting the intestinal micro ecosystem

- Antibiotics and other drug intake
- Microbial infections
- Diet (highly processed, low fiber foods)
- Chronic diarrhea
- Stress
- Chlorinated water
- Radiation and chemotherapy
- Colonic therapies for detoxification

Characteristics of Effective Probiotics

- Able to survive the passage through the digestive system.
- Able to attach to the intestinal epithelia and colonise.
- Able to maintain good viability.
- Able to utilise the nutrients and substrates in a normal diet.
- non pathogenic and non toxic.
- Capable of exerting a beneficial effect on the host.
- Stability of desired characteristics during processing, storage and transportation.
- Anti-inflammatory, antimutagenic, immunostimulatory.

Advantages

- **Produce lactic acid**- lowers the pH of intestines and inhibiting bacterial villains such as *Clostridium*, *Salmonella*, *Shigella*, *E. coli*, etc.
- Decreases the production of a variety of toxic or carcinogenic metabolites.
- Aid absorption of minerals, especially calcium, due to increased intestinal acidity.
- Production of β - D- galactosidase enzymes that break down lactose.
- Produce a wide range of antimicrobial substances -acidophilin and bacteriocin etc. help to control pathogenic bacteria .
- Produce vitamins (especially Vitamin B and vitamin K)
- Act as barriers to prevent harmful bacteria from colonizing the intestines

Colon cancer – Certain probiotics (*Lactobacillus bulgaricus*) may help prevent colon cancer by preventing the breakdown of enzymes (β - glucuronidase) that contribute to the growth of cancer causing agents.



Lowering cholesterol -

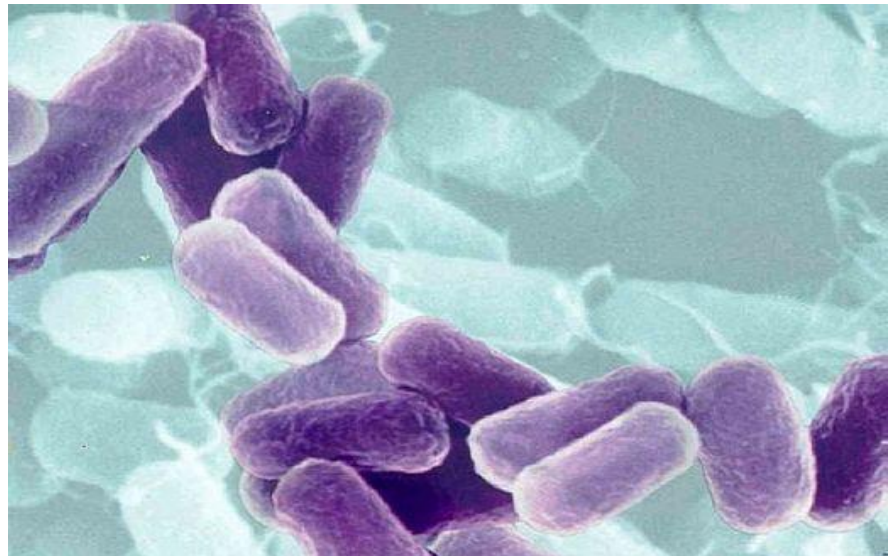
a range of LAB able to break down bile in the gut, thus inhibiting its reabsorption (which enters the blood as cholesterol)



Blood pressure reduction -Consumption of milk fermented with various strains of LAB may result in modest **reductions in blood pressure**, due to the ACE inhibition-like peptides produced during fermentation.

- **Antibiotic associated diarrhea(AAD)-**

1. Results from an imbalance in the colonic microbiota
2. Probiotic treatment can reduce the incidence and severity of AAD
3. Efficacy of probiotic AAD prevention is dependent on the probiotic strain(s) used and on the dosage.



- ✓ The intestine is the body's most important immune function-related organ
- ✓ 60% of the body's immune cells are present in the intestinal mucosa
- ✓ The immune system controls immune responses against:
 - Dietary proteins
 - Prevention of food allergies
 - Pathogenic microorganisms
 - Viruses (Rotavirus, Poliovirus)
 - Bacteria (*Salmonella*, *Listeria*, *Clostridium* etc.)
 - Parasites (*Toxoplasma*)

Beneficial Effects of Probiotics

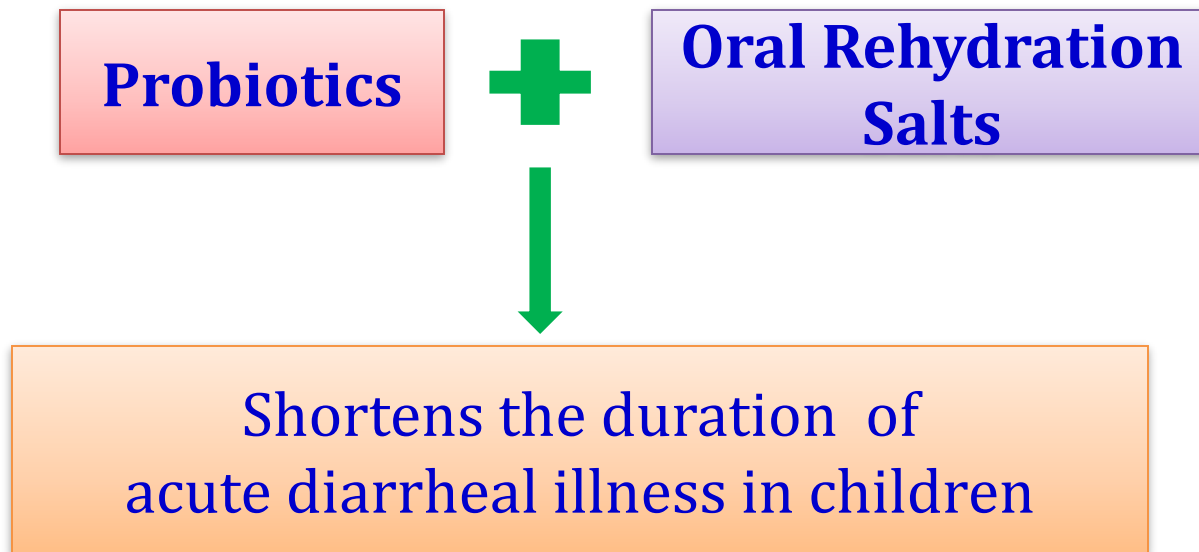
- ✓ Promote lactose digestion
- ✓ Build resistance to enteric pathogens
- ✓ Digest food and compete for nutrients with pathogens
- ✓ Produce bacteriocins to inhibit pathogens
- ✓ Modulate immune system
- ✓ Decrease blood lipids and aid in heart diseases
- ✓ Enhance intestinal barrier function
- ✓ Stimulate epithelial mucin production
- ✓ Scavenge superoxide radicals
- ✓ Compete for adhesion with pathogens
- ✓ Modify pathogen-derived toxins

Probiotics - Clinical Applications

- ✓ Diarrhea
- ✓ Colon cancer
- ✓ Cardiovascular diseases
- ✓ Prevention of *Helicobacter pylori* infection
- ✓ Allergy
- ✓ Hepatic encephalopathy
- ✓ Inflammatory bowel disease (IBD)
- ✓ Irritable bowel syndrome (IBS)
- ✓ Lactose malabsorption
- ✓ Urogenital infections

Probiotics against Diarrhea

Probiotic strains *Lactobacillus reuteri*, *L. rhamnosus* GG, *L. casei* and *Saccharomyces cerevisiae (boulardii)* significantly decreases the duration of diarrhea in children



Probiotics

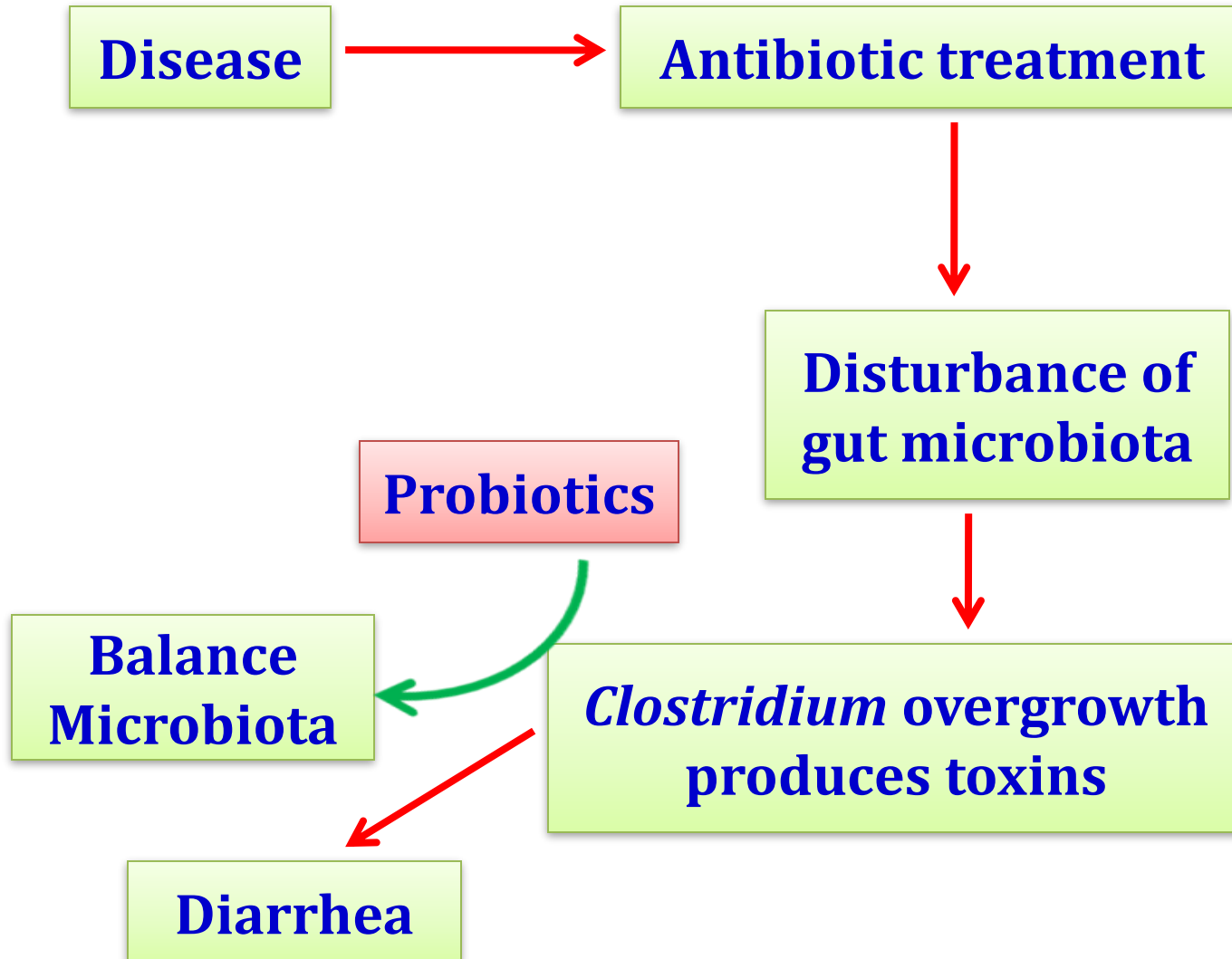


- Modulation of gut microbiota
- Production of antimicrobial substances
- Competition for adhesion sites
- Stimulation of mucus secretion
- Modulation of immune response

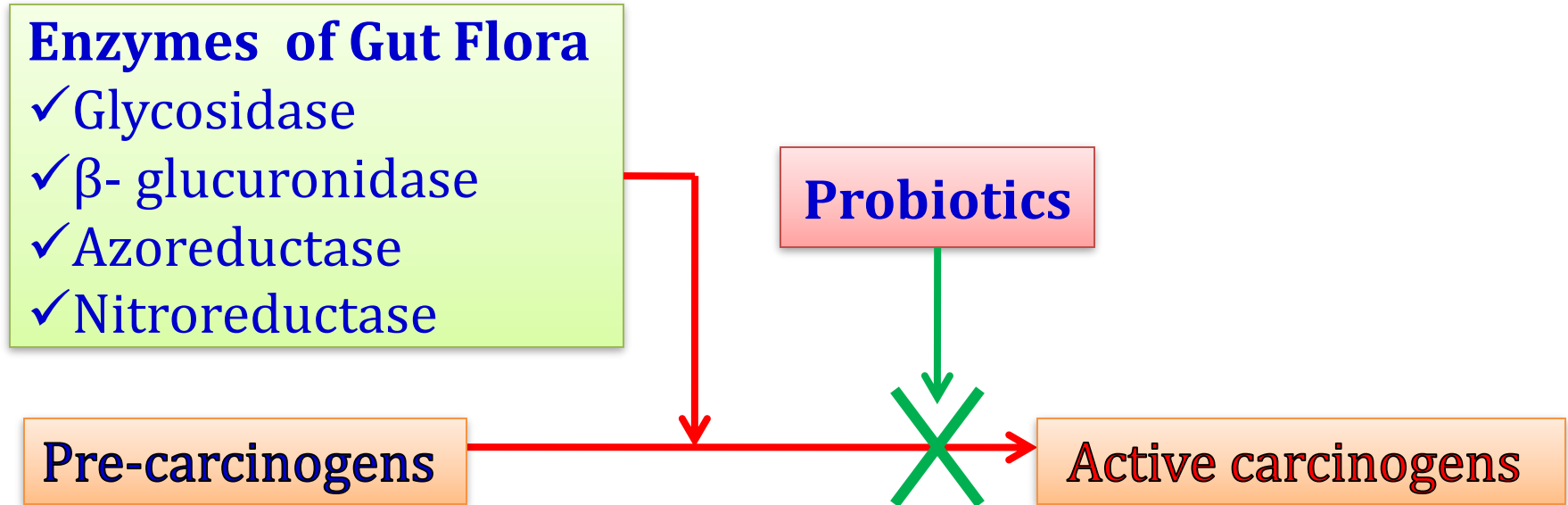


Prevention of Diarrhea

Antibiotic Associated Diarrhea



Probiotics and Cancer



- ❖ Oligofructose plus two probiotic strains (*L. acidophilus* and *L. casei*) supplementation in humans helped to decrease levels of these gut flora enzymes

Probiotics



- Binding/inactivation of mutagenic compounds
- Production of anti-mutagenic compounds
- Suppression of growth of pro-carcinogenic bacteria
- Reduction of the absorption of carcinogens
- Enhancement of immune function
- Influence on bile salt concentrations



Prevents Cancer Growth

Probiotics and Heart Diseases

Probiotics



- Assimilation of cholesterol by bacterial cells
- Deconjugation of bile acids by bacterial acid hydrolases
- Cholesterol-binding to bacterial cell walls
- Reduction of hepatic cholesterol synthesis
- Redistribution of cholesterol from plasma to liver
- Bacterial production of short-chain fatty acids



Reduction of blood cholesterol level

Helicobacter pylori Infection

Probiotics



- Production of antimicrobial substances
- Stimulation of the mucus secretion
- Competition for adhesion sites
- Stimulation of specific and non-specific immune responses



Prevention of *Helicobacter pylori* infection

Probiotics and Allergy

Probiotics



- Reverse increased intestinal permeability
- Enhance gut-specific IgA responses
- Promote gut barrier function
- Modulation of immune response
- Enhance IL-10 and cytokines production that promote production of IgE antibodies



Beneficial in Allergy and
Atopic diseases

Hepatic Encephalopathy

Probiotics



- Decrease portal blood ammonia by reduced bacterial urease activity
- Decrease portal blood pH due to less ammonia absorption
- Decrease inflammation and oxidative stress due to reduced ammonia toxins
- Reduce uptake of other toxins



Prevention of Hepatic
Encephalopathy

Inflammatory Bowel Disease

Probiotics



- Modulation of immune response
- Modulation of gut microbiota



**Beneficial in Inflammatory
Bowel Disease**

Ulcerative colitis

- ✓ The probiotic strain *E. coli* Nissle strain may be equivalent to Mesalazine in maintaining remission of ulcerative colitis
- ✓ Probiotics have shown efficacy to induce and maintain remission in children and adults with mild-to-moderate ulcerative colitis

Irritable Bowel Syndrome

Probiotics



- Reduction of intestinal gas production
- Modulation of gut microbiota



Beneficial in Irritable Bowel Syndrome

- ❖ Probiotic strains *Bifidobacterium Infantis* in addition to *Lactobacillus reuteri* may improve **Colicky** symptoms within one week of treatment

Lactose Malabsorption

Probiotics



Action of bacterial β -galactosidase on lactose



Relief from Lactose Indigestion

❖ *Streptococcus thermophilus* and *L. delbrueckii* subsp. *bulgaricus* improve lactose digestion and reduce symptoms related to lactose intolerance

Urogenital Tract Disorders

Probiotics



- Production of antimicrobial substances
- Competition for adhesion sites
- Competitive exclusion of pathogens



Relief from Urogenital Infection

Probiotics in Pregnancy

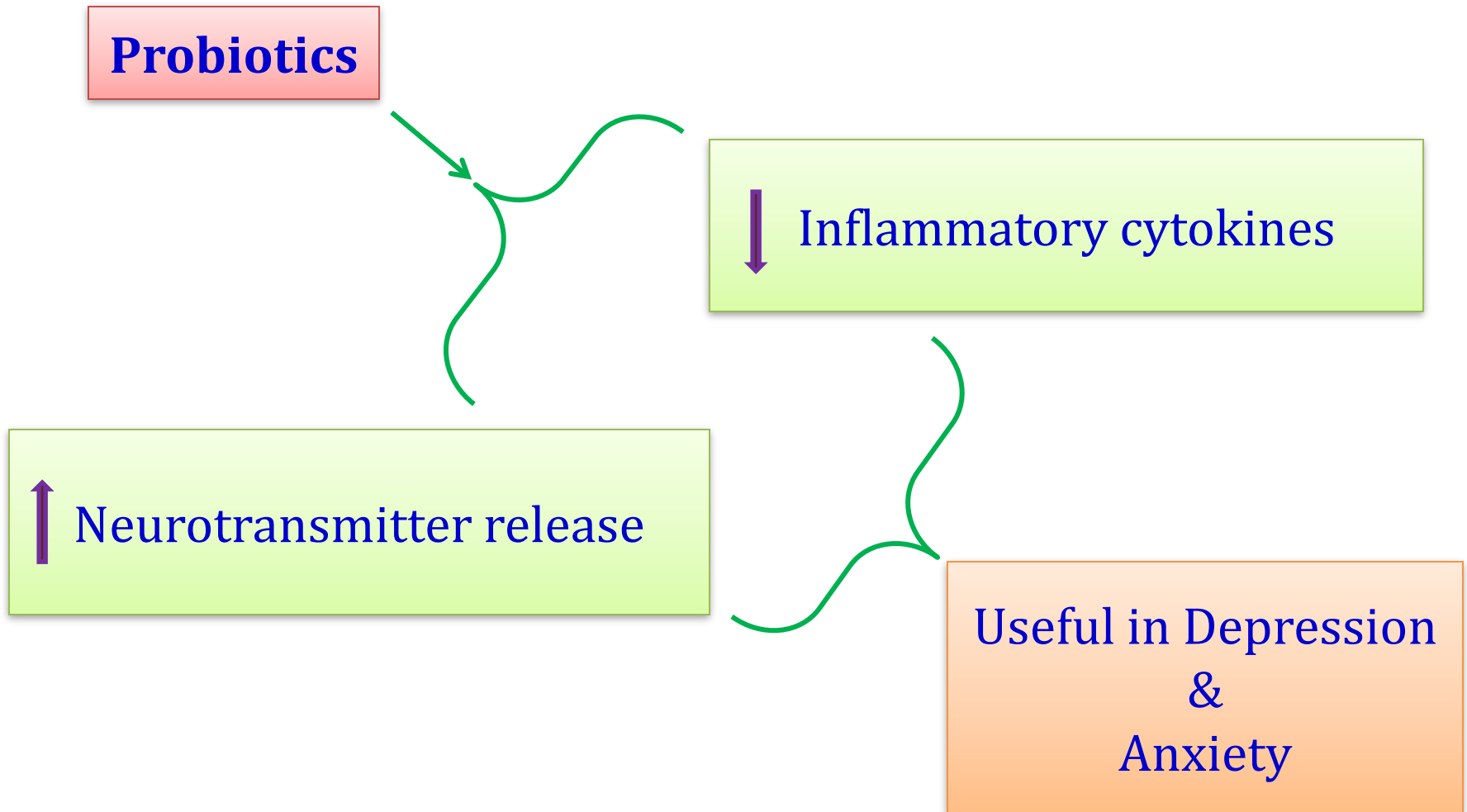
- ❖ **Bacterial vaginosis**, increases the risk of **preterm labour** and **infant mortality**
- ❖ Probiotics decrease the risk of **bacterial vaginosis** and maintain normal *Lactobacilli* vaginal flora
- ❖ *L. rhamnosus* GG and *B. lactis* BB12 can be prevented atopic dermatitis of newborn babies in 50% of cases, if mothers ingest probiotics during pregnancy and newborns ingest them during the first 6 months of life

Probiotics in Skincare Products

- ❖ Probiotic skincare product **Skincare**® was first introduced in 2007 by **NUDE Brands Ltd.**, UK/USA
- ❖ Probiotics help balance internal digestion and also stabilize microflora on the skin
- ❖ **Yogurt** increases certain probiotic strains in skin that protect skin from environmental stressors, soothes skin and improves moisture retention

Future Trends and Research

The benefits of probiotics go way beyond gut health



Probiotics



**Reduces pathogenic bacteria in the nasal passages
Balances microflora in the nasal cavity**



**Useful in Nasal Congestion
&
sinusitis**

Probiotics

↓ Inflammatory cytokines in skin

↑ Microbial flora in skin

Useful in Acne, Psoriasis, Eczema and Dermatitis

Probiotics

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graph TD; A[Probiotics] --> B[Development of new strains]; B --> C[Improves insulin sensitivity<br/>Facilitates glucose transport<br/>Reduces blood LDL level]; C --> D[Useful in Type-2 Diabetes<br/>&<br/>Obesity];
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Development of new strains

Improves insulin sensitivity
Facilitates glucose transport
Reduces blood LDL level

Useful in Type-2 Diabetes
&
Obesity

Probiotics



Production of antibiotic that kills pathogenic microbes



Development of oral hygienic products



Probiotic strains incorporate into antiseptic powder and lotions



Probiotic Food Sources

- Fermentation
 - Lactobacillus and Bifidobacterium
 - Bioavailability
- Dairy
 - Yogurt with “active cultures”
 - Kefir
- Non-Dairy
 - Non-dairy yogurt
 - Fermented soy (tempeh, miso or natto)
 - Fermented vegetables (sauerkraut or kimchi),
 - Kombucha tea



What are Prebiotics?

- Non-digestible substances that feed the probiotics and help them thrive in the GI tract
- Greater Stability
- Release short-chain acids which decrease the pH of the colon
 - Helps enhance mineral absorption (especially calcium, iron and magnesium)
 - Decreases survival of pathogens
- Helps decrease cholesterol
- May reduce the risk of colon cancer



Sources of Prebiotics

- Chicory root
- Jerusalem artichoke
- Wheat
- Barley
- Rye
- Flax
- Oatmeal
- Onion
- Garlic
- Leeks
- Legumes
- Asparagus
- Leafy greens
- Berries
- Bananas
- Honey
- Prebiotic supplement
- Prebiotic-fortified foods and beverages





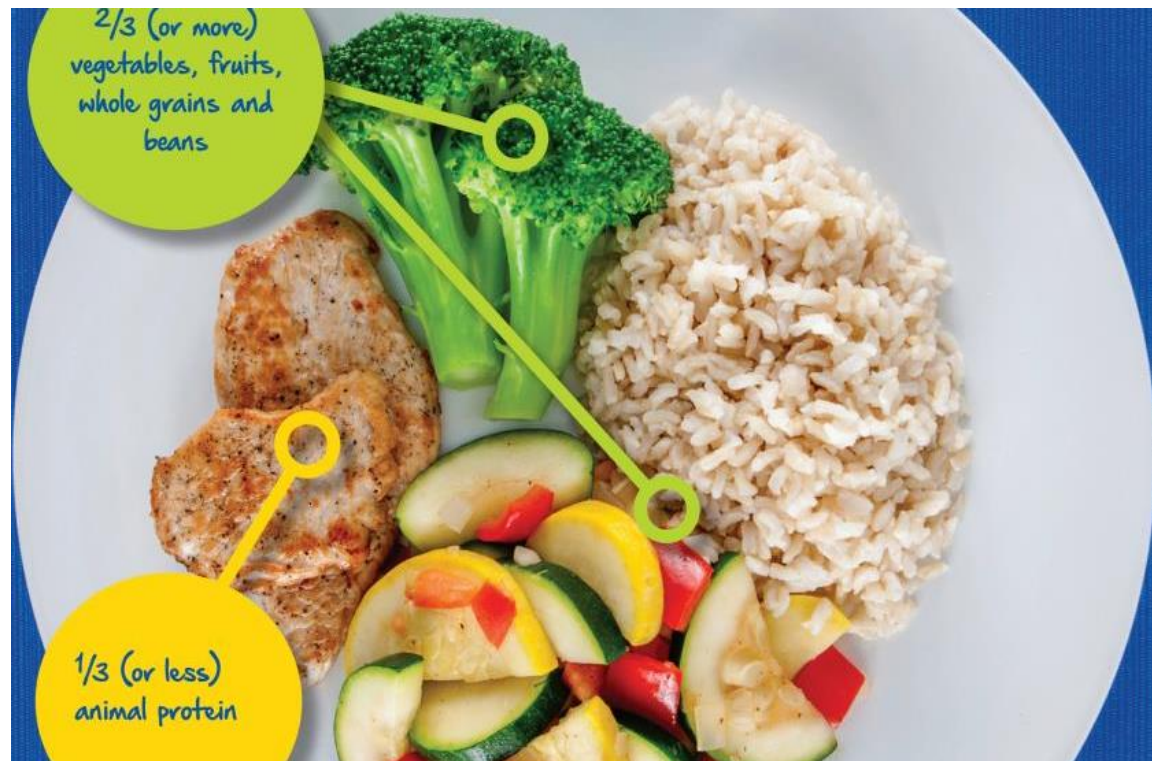
Ideal properties of a Probiotic

- 1. Be nonpathogenic and nontoxic to the host**
- 2. Be antagonistic to pathogens**
- 3. Exert a beneficial effect on the host**
- 4. Capable of surviving, colonizing and proliferating in the gut (should not be killed by gastric juice / bile acids)**
- 5. Able to inhabit in the S & L intestine**
- 6. Must be of human origin**
- 7. Contain a large number of viable cells and remain viable during storage and use**

What can you do to improve your gut health?

- Change your diet
 - Plant based diet
 - High fiber diet that includes fiber from a variety of different sources
 - Limit excess calorie consumption
 - Limit sugar and fatty, processed foods
 - Cut back on caffeine and alcohol
 - Consume probiotic rich foods
- Do not overuse antibiotics
- Manage stress
- Get enough sleep
- Exercise





Conclusion

- ❖ Probiotics have clearly established as an adjuvant in the management of lactose malabsorption and acute diarrhea, particularly acute infant diarrhea
- ❖ Probiotic agents appear promising for the management of *C. difficile* colitis, atopic disease, necrotizing enterocolitis and other gut conditions, such as inflammatory bowel disease
- ❖ Further, well-designed clinical trials, involving large numbers of patients, are mandatory to achieve definite evidence of the preventive and curative role of probiotics in medical practice

Thank you all

