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 infantry probiotics supplied from raw foods; such as lactic acid fermented foods such as yogurt, cheese and probiotic supplements.

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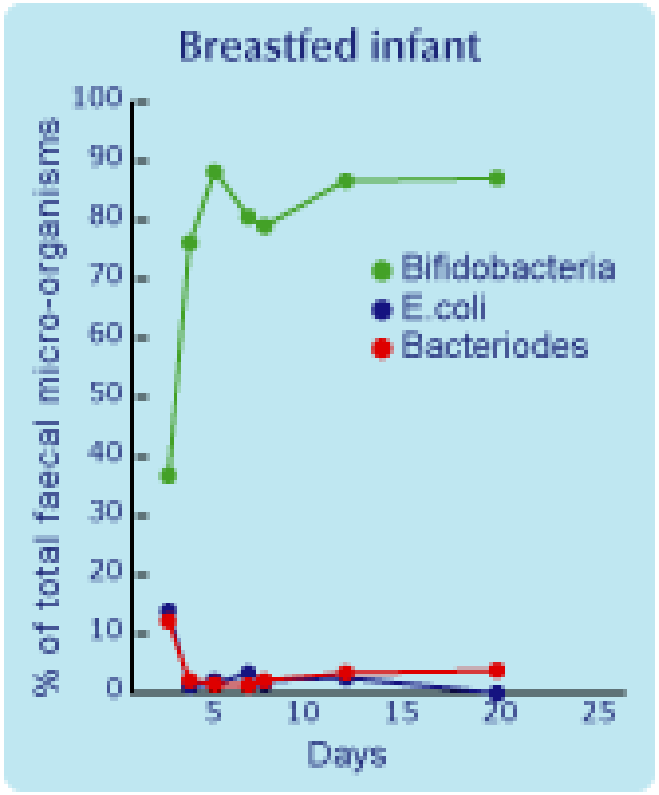
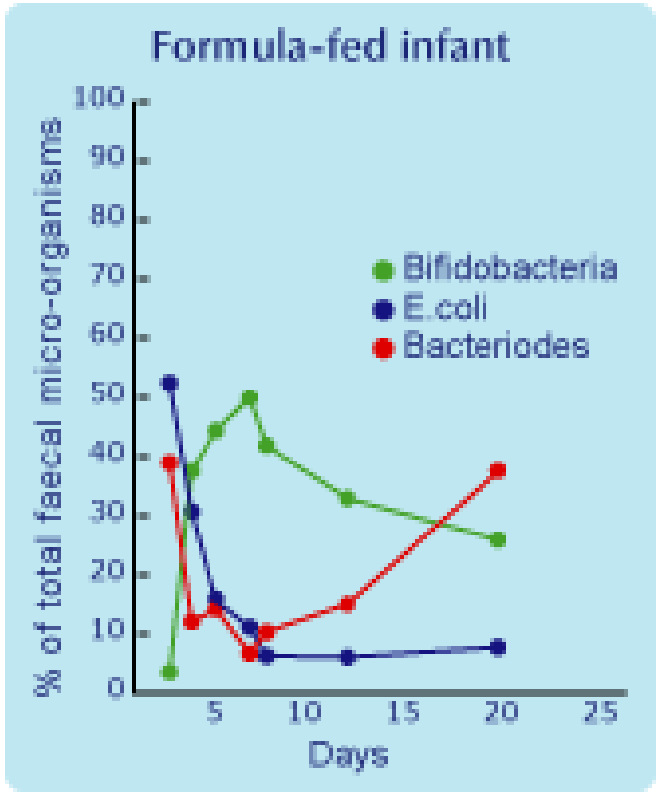
# Gut Flora in Breast Fed vs Formula Fed Babies




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 benificial 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 bulcaricus)*** 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)

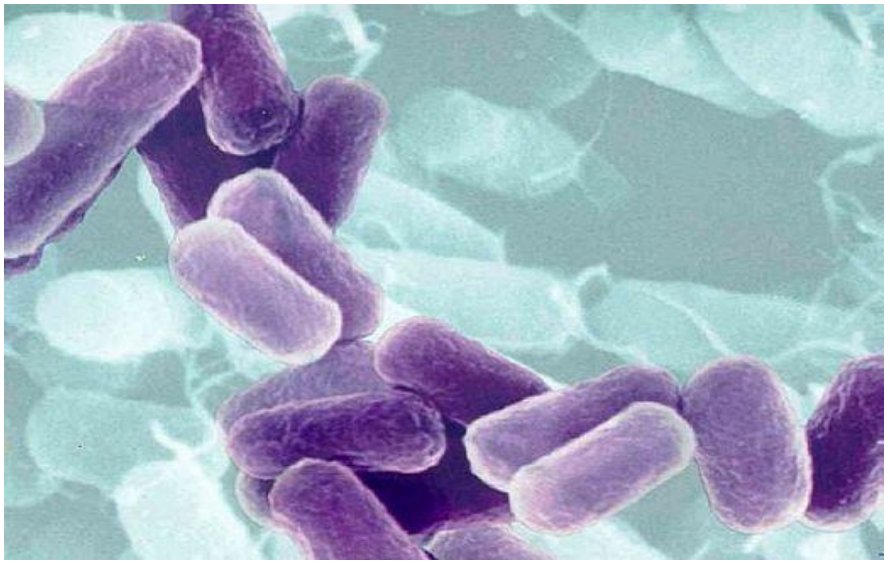
**Blood pressure reduction -**Consumption of milk fermented with various strains of LAB may result in modest **reductions in blood pressure**, due to the ACE inhibition-like peptides produced during fermentation.

- **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

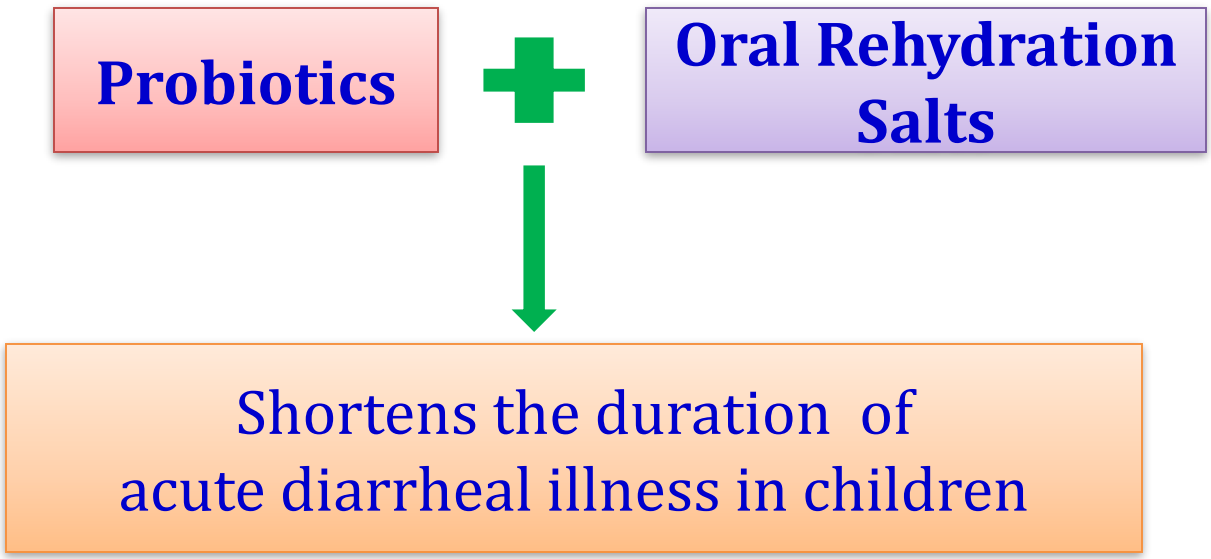
- ✓ Promote lactose digestion
- ✓ Build resistance to enteric pathogens
- ✓ Digest food and compete for nutrients with pathogens
- ✓ Produce bacteriocins to inhibit pathogens
- ✓ Modulate immune system
- ✓ Decrease blood lipids and aid in heart diseases
- ✓ Enhance intestinal barrier function
- ✓ Stimulate 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**

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

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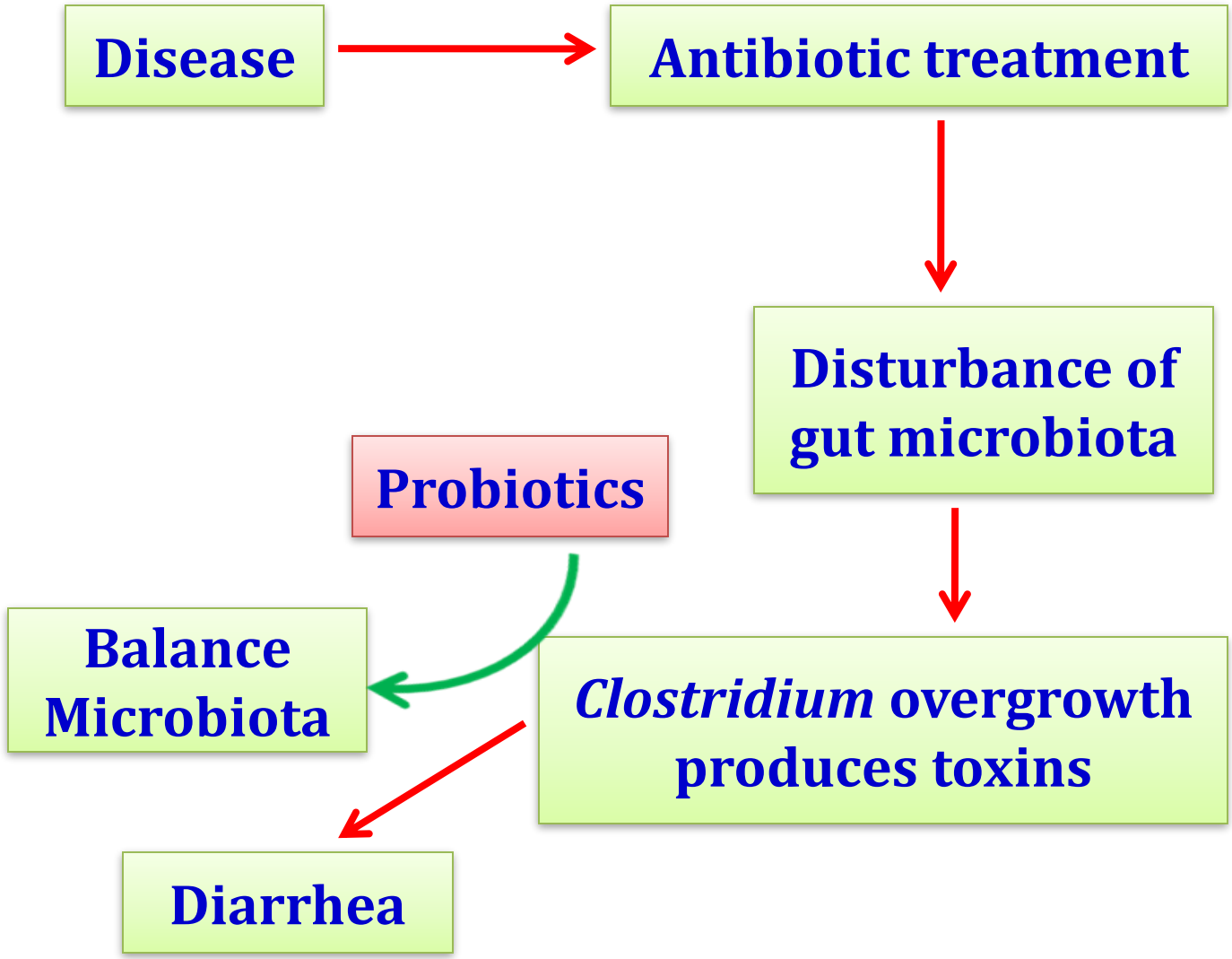
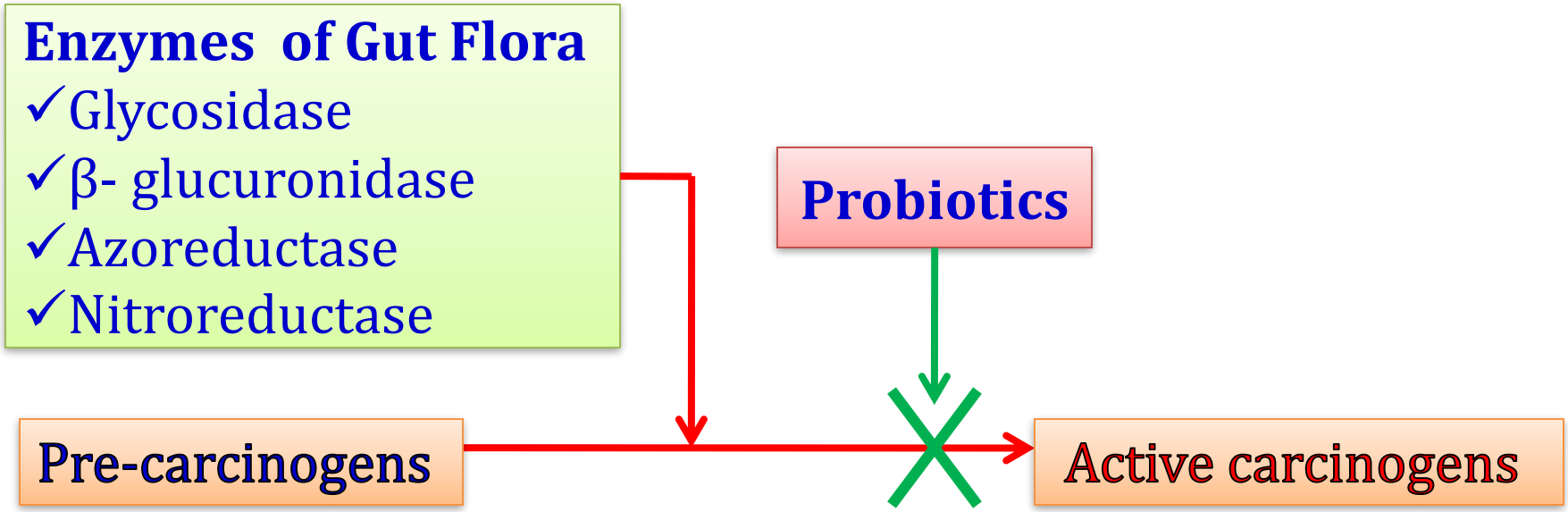
Prevention of Diarrhea

# 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**

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- 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

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Prevents Cancer Growth

# Probiotics and Heart Diseases

**Probiotics**

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- 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

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Reduction of blood cholesterol level

# *Helicobacter pylori* Infection

**Probiotics**

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

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Prevention of *Helicobacter pylori* infection

# Probiotics and Allergy

**Probiotics**

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- 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

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Beneficial in Allergy and Atopic diseases

# Hepatic Encephalopathy

**Probiotics**

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- 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

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Prevention of Hepatic Encephalopathy

# Inflammatory Bowel Disease

**Probiotics**

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- Modulation of immune response
- Modulation of gut microbiota

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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**

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- Reduction of intestinal gas production
- Modulation of gut microbiota

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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**

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Action of bacterial β-galactosidase on lactose

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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

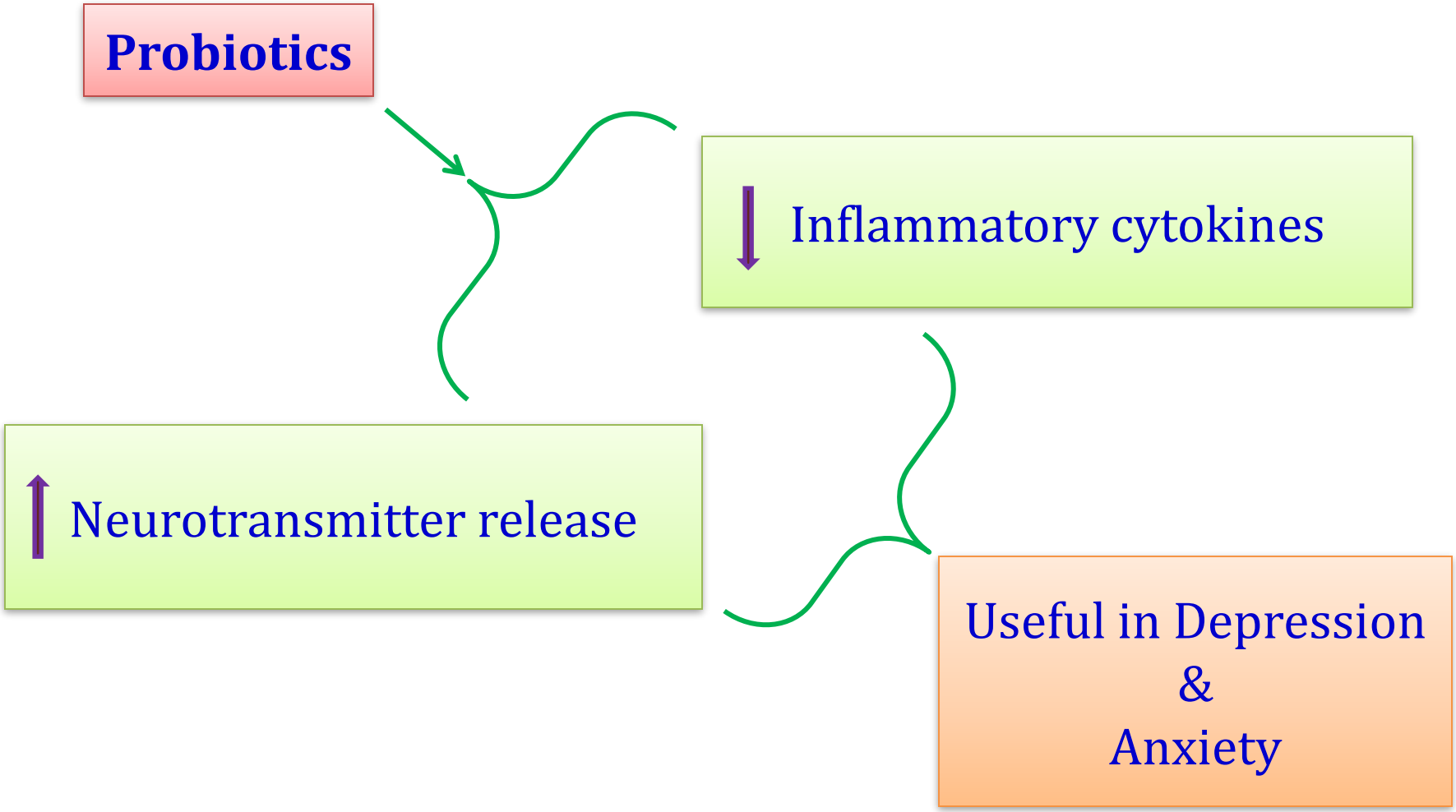
- **Bacterial vaginosis**, increases the risk of **preterm labour** and **infant mortality**
- Probiotics decrease the risk of **bacterial vaginosis** and maintain normal *Lactobacilli* vaginal flora
- ***L. rhamnosus* GG** and ***B. lactis* BB12** can be prevented atopic dermatitis of newborn babies 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 introduce 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**

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

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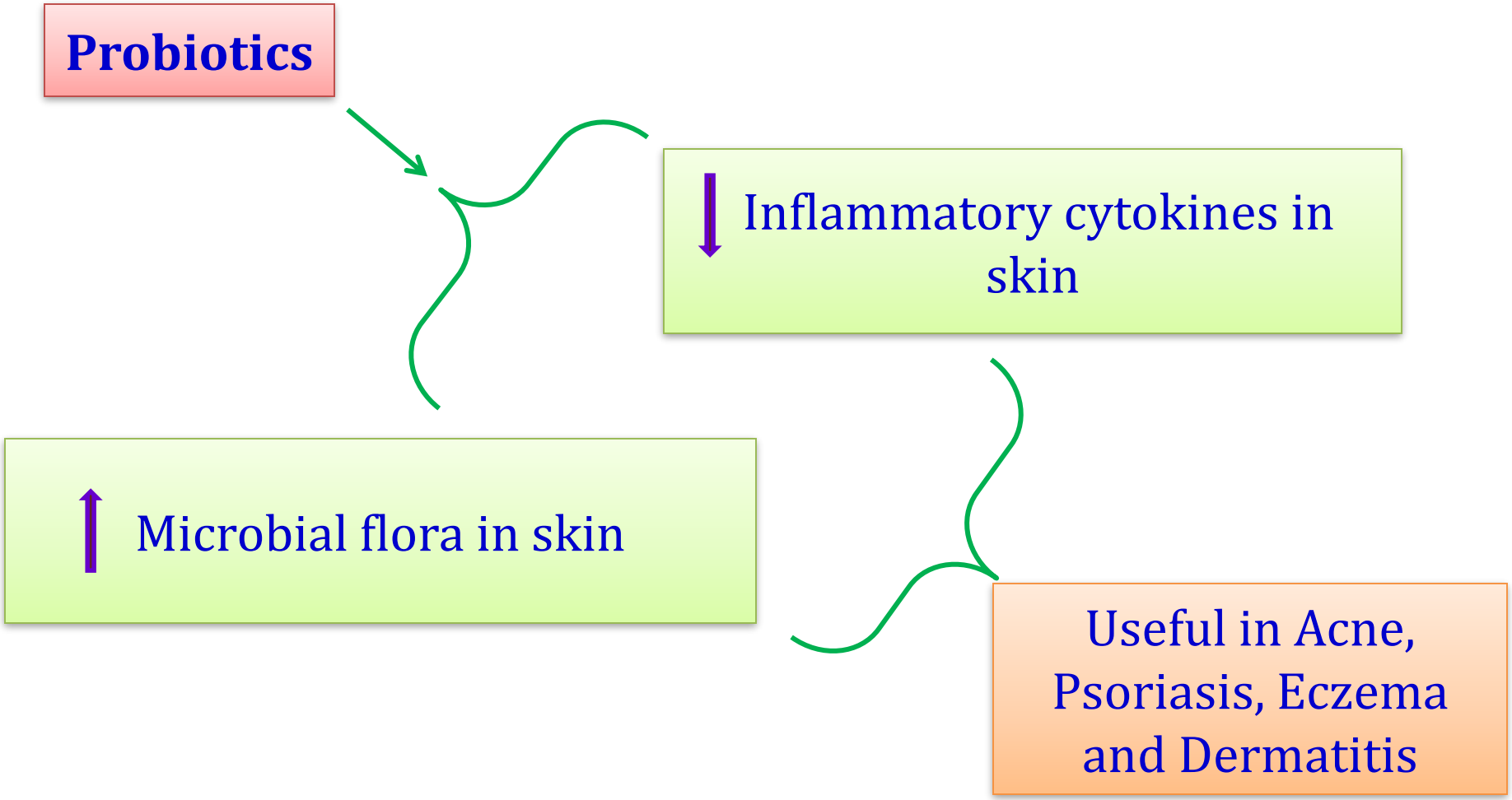
Useful in Nasal Congestion
&
sinusitis


Probiotics
Inflammatory cytokines in skin
Microbial flora in skin
Useful in Acne, Psoriasis, Eczema and Dermatitis

**Probiotics**

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Development of new strains

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Improves insulin sensitivity
Facilitates glucose transport
Reduces blood LDL level

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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 kir…),
  - 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


CRYSTAL LIGHT
LivActive
10

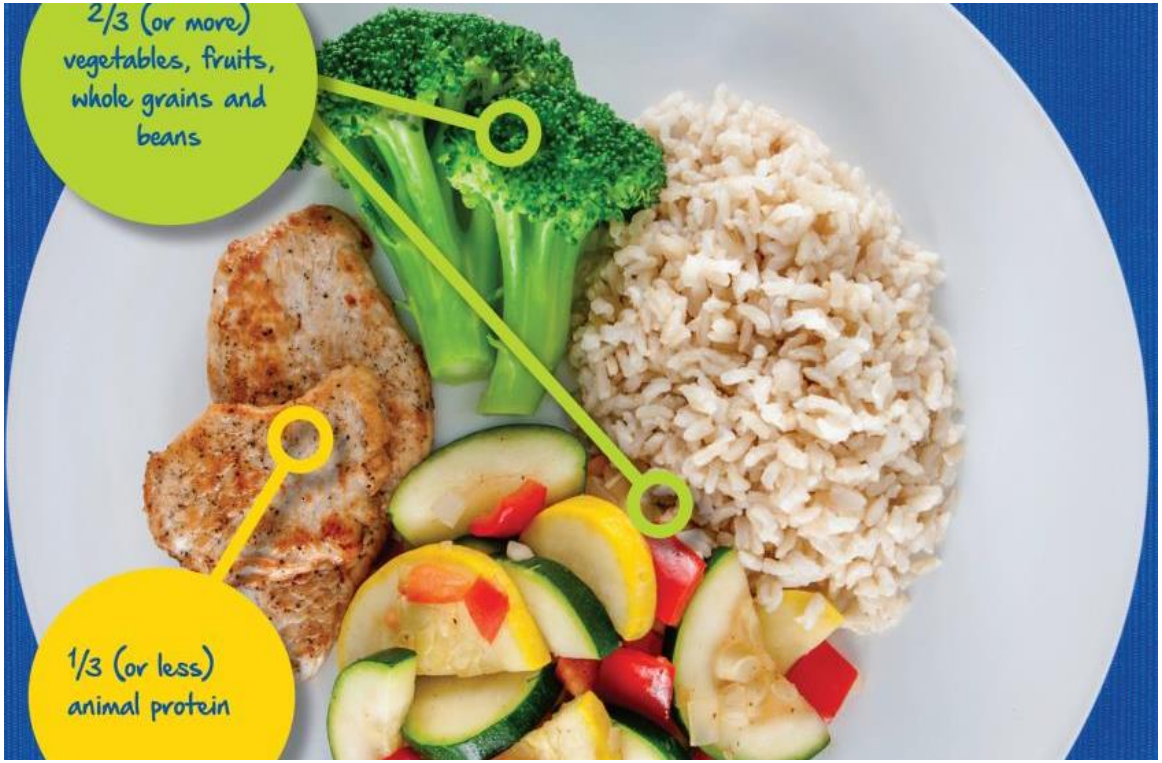

Breakstone's
LivActive
Lowfat Cottage Cheese with Pineapple
2% MILKFAT LOWFAT COTTAGE CHEESE WITH PINEAPPLE
Eat active. Feel active. LiveActive.

# 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


2/3 (or more) vegetables, fruits, whole grains and beans
1/3 (or less) animal protein

# 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