



An overview of Beneficial effects on health & nutritional properties



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What are probiotics?

Etymologically, the term appears to be a composite of the Latin preposition pro("for") and the Greek adjective (biotic), the letter deriving from the noun (bios, "life")

1965, Lilly & Stilwell: substances secreted by one organism that stimulate another microorganism.

1971, Sperti: described tissue extracts which stimulated microbial growth.

1974, **Parker:** "Organisms and substances that have a beneficial effect on the host animal by contributing to its intestinal microbial balance"

1989, Fuller "live microbial feed supplement which beneficially affects the host animal by improving its intestinal microbial balance.
 2002, WHO " live microbes which when administered in adequate amounts confirm a beneficial health effect on the host"



Lactobacillus species

- L. acidophilus
- L. casei (rhamnosus)
- L. reuteri
- L. bulgaricus
- L. plantarum
- L. johnsonii
- L. lactis

Others

Bacillus cereus

Non pathogenic Escherichia coli

Saccharomyces cerevisiae

Enterococcus faecalis

Streptococcus thermophilus

Bifidobacterium species

- B. bifidum
 B. longum
 B. breve
 B. infantis
 B. lactis
- B. adolescentis



Background

Origin of the probiotic concept with
 <u>Elie Metschnikof</u> and his observations
 of the longevity of Balkan peasants who
 ate a diet containing large quantities of
 fermented milks.



Elie Metschnikof, pioneer immunologist and Nobel Laureate. His observations concerning Balkan peasants were unscientific and based on a few cases.

Despite a high yoghurt consumption he died aged



Concept of Probiotics

- Our body is host to microorganisms or bacteria that are essential to our health known as gut flora or normal microbial flora.
- These bacteria may be beneficial or harmful.
- > Although beneficial microbial population gets altered by use of antibiotics and other factors.
- \blacktriangleright By introducing friendly microbes in the form of probiotics resident flora can be improved over a period of time.



Probiotic Microorganisms

- A very wide range of microorganisms have been considered to have probiotic properties.
- Lactic acid producing bacteria-
- Lactobacilli and bifidobacterium
- Yeast(Saccharomyces) and others.

Lactobacillus

Acid tolerant

Lactic acid as the major metabolic end

product



- > Source:
- Raw and fermented dairy products
- Fresh and fermented plant products
- The reproductive and intestinal tracts of
 - humans and other animals.

Bifidobacterium

- ➤Saccharolytic organisms
- Produce acetic and lactic acids
 - without generation of CO₂
- They are lactic acid bacteria (LAB)





Status of probiotic cultures at Global level

- ►L. rhamnosus GG (Valio)
- ►L. caseiShirota (Yakult)
- ➤ L. plantarum 299v (Probi AB)
- L. johnsonii La7 (Nestle)
- ➤ L. reuteri (BioGaia)
- L. acidophilus NCFM (Nestle)
- L. casei strain DN-114001 (Danisco)
- ➢ B. animalis DN 173010 (Danisco)
- ➤ L. rhamnosus 271 (Probi AB)





Food containing Probiotics

≻ Milk

- Soya milk
- ≻ Tofu

➢ Milk products- Sour cream, Butter milk, Yogurt

- Fermented Indian foods like
- Idlis
- Dosas
- Dhoklas
- Vadas
- ✤ Kadhi







Features of Probiotics

- ➢ Non-pathogenic
- ➤ Nontoxic
- Resistant to gastric acid
- Adhere to gut epithelial tissue
- Produce antibacterial substances
- ➢ It should persist for short periods in the gastro-intestinal tract
- Able to resist the antibacterial mechanisms that operate in the gut
- Need to avoid the effects of peristalsis, which tend to flush out bacteria with food
- ► Resistant to the bile acid



Beneficial effects of probiotics

> Aid in lactose digestion

- Resistance to enteric pathogens
- > Anti-colon cancer effect
- Immune system modulation
- > Allergy
- ➢ Blood lipids, heart disease
- > Antihypertensive effect
- Urogenital infections
- ➢ Gut colonization



Actions of probiotics

Alter host immune responses

stimulate IgA production

↓ proinflammatory cytokines

•Produce β-galactosidase, so digest lactose

• production of carcinogenic metabolites



Mechanism of action of Probiotics

Production of low-molecular-weight antibacterial substance that inhibits both gram-positive and gram-negative enteric bacteria

Also use enzymatic mechanisms to modify toxin receptors and block toxin-mediated pathology

Also prevent colonization of pathogenic microorganisms by competitive inhibition for microbial adhesion sites



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Effect of Probiotics on tight junctions

- Tight junctions are highly regulated
 macromolecular structures that link
 epithelial cells to one another forming an
 intracellular barrier.
- Probiotics reduce the levels of microorganisms such as E. coli, and Salmonella that attack tight junctions.
- Probiotics restore and maintain the patency of tight junctions,

thus restricting pathogens into the bloodstream.

Diarrhea

Type of Diarrhea	Pathogen	Probiotic used
<i>Clostridium difficile</i> diarrhea	Clostridium difficile	Lactobacillus GG
Traveler's diarrhea	Enterotoxigenic Escherichia coli	Saccharomyces boulardii
Pediatric diarrhea	Campylobacter, Salmonellae, Shigellae	Lactobacillus GG and Bifidobacterium

The beneficial effect was shown to be accompanied by a greater immunoglobulin A-antibody secreting response and less rotaviral shedding in children treated with these agents.



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Anticancer effects

High animal fat and protein Diet

Increase the susceptibility to colon cancer by conversion of pre-carcinogens to carcinogens by the intestinal micro flora

Enzymes (Glycosidase, B-glucuronidase, azoreductase, and nitroreductase)

Pre-carcinogens

Active carcinogens

Activity of *L. acidophilus and L. casei* supplementation in humans helped to decrease levels of these enzymes.



Lactose Intolerance



Lactose- intolerant individuals tolerate yogurt mainly due to the supply of lactase activity from the lactic acid bacteria present in the yogurt itself.

- Lactose deficiency leads to calcium malabsorption
- Acidic condition = Calcium absorption is more
- Production of lactic acid by hydrolysis of milk lactose by Probiotics.



Degradation/structural modification of antigens.

➢Normalization of the properties of aberrant indigenous microbiota.

≻ Regulation of the secretion of inflammatory mediators.

➢Stimulating immune response and reduction of serum IgE levels.

>Lactobacillus and Bifidobacterium improve mucosal barrier function.

Probiotics have been shown to reduce the incidence of childhood eczema.

 \succ Probiotics have been shown to control lactose intolerance.

Improvements for survival of probiotics

Heat from pelleting and long storage of products may render the non viability of the product. For improving the survival of probiotic cultures following practices has been applied....

Micro encapsulation	 Entrapment of microorganisms with artificial/biological membranes/supports/ coverings
Prebiotics	 Addition of prebiotics such as inulin,oligosaccharides etc
Other food supplements	 Addition of other food additives such as fibres, vitamins etc.

Prebiotics

A selectively fermented ingredient that allows specific changes, both in the composition and/or activity of the gastrointestinal microflora that confers benefits upon the host wellbeing and health.

Prebiotics + Probiotics = Synbiotics

Characteristics of Prebiotics

Non Digestible or partially digestible

Well fermented by beneficial bacteria in the gut

Non Absorbable in the small intestine

Poorly fermented by potentially pathogenic bacteria in the gut

Poorly fermented by bacteria in the mouth

Frequently used Prebiotics (Non digestible oligosaccharides NDOs) Inulin and oligofructose; Galactooligosaccharides; Lactulose

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Prebiotics are non-digestible but fermentable oligosaccharides

that are specifically designed to change the composition and

activity of the intestinal microbiota with prospect to promote the

health of the host."

Fig. shows general structure of fructooligosaccharides.



Mode of action of Prebiotics





Applications of Prebiotics

- > Can be consumed as dietary supplements or in functional foods.
- Prebiotic compounds may also be added to animal feed, as an alternative to antibiotics.
- Reduce carriage of enteric pathogens, thereby preventing transmission to humans.
- Dietary prebiotics sourced from seaweeds may provide a means to modulate the intestinal microbiota thereby improving the overall health of animals and humans.



A synbiotics is a combination of one or more probiotics and prebiotics."



Probiotic Products

- Yoghurts and related products-containing <u>Lactobacillus acidophilus</u> and <u>bifidobacterium spp.</u>
- > Other dairy products include cheese, ice-creams.
- Non Dairy products-Limited range of yoghurt analogues, usually soy based, cereal based fruit drinks.
- > Also available in the form of <u>tablets</u>, <u>capsules</u>.

Amul Probiotic products



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Who needs probiotics?

- People who suffer from yeast infections of any kind, including athlete's foot, jock itch, vaginal yeast infections and nail fungus.
- People with weak immune system, frequent respiratory infections and congestion.
- > People with food or respiratory allergies.
- People suffering from inflammatory bowel disorders, constipation or intestinal infections
- People who travel can avoid infections from foreign food and water by taking probiotics with meals.
- Probiotics can also be given to children and infants to reduce the risk of infection.

Current problems with "probiotics" in India

- Extravagant claims without research
 - Specific species and strain effects
- Lack of good manufacturing practices
 - Quality assurance
 - Label vs content
 - Viability of bacterial species
- > Validated biomarkers for assessing function and activity
- > No specific guidelines currently In India

Looking Ahead from Indian Perspective..

- Elucidate the physiological role and mechanism of action probiotics.
- Initiatives for mining the complete genome of promising Indian strains and the functional genes associated with novel physiological function.
- Identification of potential Biomarkers for evaluating functionality of probiotics.
- Determine the role of probiotics as part of a whole food compared to isolated component
- Improve reliability and ease of taxonomic classification of probiotic bacteria. Improve strain performance and activity
- Efforts should be made to conduct clinical trials in Indian population for comprehensive evaluation of the efficacy of the Indian probiotic cultures

<u>Danone India introduces probiotic drink in Mumbai</u> <u>(0</u>8 Sep 2009)

- Groupe Danone of France (Danone India Pvt. Ltd) has signed a joint venture with Yakult Honsha, Japan, to launch <u>Yakult</u> drink in Mumbai, a global probiotic health drink.
- > In India, Yakult is priced at <u>Rs 60</u> for a pack of 5 bottles.





Eat Probiotics foods, live healthy life

So.....

Eat the "good bugs" every day.....

Invite them in.....

You will find they make very friendly

houseguests.



Genetically Engineered Probiotics

Use of genetically modified Probiotics as TMAU Trimethylaminuria

> A genetically modified *Bacteroides ovatus* and Xylan in small amounts to improve as a therapy to animals with colitis.

Benefits of Genetic engineering:

- Strengthen the effects of existing strains
- Create completely new Probiotics. These need not necessarily be composed only of bacterial products but can also include elements of regulatory systems or enzymes derived from a foreign—human source. > As vector for vaccines and growth hormones

Commercial Probiotic Strains

Probiotic Strain	Commercial Product
L. acidophilus	LA-5; NCDO 1748
Saccharomyces cerevisiae (boulardii)	Florastor Biocodex (Creswell OR)
<i>L. casei</i> Shirota <i>B. breve</i> strain Yakult	Yakult
<i>L. johnsonii</i> Lj-1 (same as NCC533 and formerly <i>L. acidophilus</i> La-1)	LC-1 Nestlé (Lausanne, Switzerland)
L. reuteri ATCC 55730 ("Protectis")	BioGaia Probiotic chewable tablets or drops
Streptococcus oralis KJ3 Streptococcus rattus JH145	ProBiora3 Oragenics Inc. (Alachua FL)
Lactobacilli rhamnosus PBO1 Lactobacilli gasseri EB01	EcoVag Bifodan (Denmark)

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Status of Probiotics in India

- Used as animal feed supplements for cattle, poultry and piggery.
- Yakult Dannone released their Probiotic drink named Yakult.
- The latest and recent addition to the list of probiotics in India is ViBact (which is made up of genetically modified *Bacillus mesentricus*), which acts as an alternate to B-complex capsules launched by US Vitamins.
 - Probiotic yogurts have been launched by Mother Dairy.



Indian and Global Probiotic manufacturers

- Mirobax Hyderabad
- Unique Biotech Hyderabad
- Alliance Bioscience Pvt Ltd –

Pondicherry

Agri Life

SOM Phytopharma (India) Limited -

Hyderabad

- Ruchi Biochemical's Mumbai
- Sami Labs Ltd.- Bangalore

Tablets India

Mother Dairy © Powered Templates.com UAS Laboratories Inc. a leading

Probiotic company, was founded

by Dr. S.K. Dash in 1979.

- Shandong Bolylely Bioengineering
 - <u>Co., Ltd</u>China
- Danisco
- Chr. Hansen A of Denmark
- Yakult Danone
- US-based VSL Pharmaceuticals
- Alkem Health Foods (Prebiotics)

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