



Pro and Pre-biotics for Human Health

The composition of the diet has a strong influence on intestinal physiology and the metabolism of the micro flora. It is well documented that differences in food components namely proteins, lipids and carbohydrates cause alterations in the composition of bacteria in gastrointestinal tract. The colon is the main site for microbial colonization with more than 500 different species of bacteria. The gut micro flora plays an important role in human health and disease. The gut micro flora acts as an important modulator of the immune system and serves as an important source of non inflammatory immune stimulators throughout life in healthy individuals.



Gibran and Roberfroid (1995) defined a **prebiotic** as “non digestible food ingredient that beneficially affects the host by selectively stimulating the *growth* or activity of a limited number of bacteria in the colon”

Probiotics are dietary supplements containing potentially beneficial bacteria or yeasts. According to the currently adopted definition by FAO/WHO, Probiotics are: ‘Live microorganisms which when administered in adequate amounts confer a health benefit on the host’. **Probiotic** may also defined as a “live microbial feed supplement, which beneficially affects the host by improving its intestinal microbial balance”

Concept of Probiotic

Probiotic is the most frequently used dietary method of influencing the gut flora, whereby live microbial

additions are made to appropriate food vehicles. The following criteria must be met before a probiotic can be described as useful

- The probiotic must be capable of being prepared in available manner and on a large scale (e.g., for industrial purposes)
- During use, and under storage the probiotic should remain viable and stable
- It should be able to survive in the intestinal ecosystem
- The host animal should gain beneficially from harboring the probiotic

Lactic acid bacteria (LAB) are the most common type of microbes used. LAB have been used in the food industry for many years, because they are able to convert sugars (including lactose) and other carbohydrates into lactic acid. This not only provides the characteristic sour taste of fermented dairy foods such as yogurt, but also by lowering the pH may create fewer opportunities for spoilage organisms to grow, hence creating possible health benefits on preventing gastrointestinal infections. Strains of the genera *Lactobacillus* and *Bifidobacterium*, are the most widely used probiotic bacteria.

Probiotic bacterial cultures are intended to assist the body's naturally occurring gut flora, an ecology of microbes, to re-establish themselves. They are sometimes recommended by doctors, and more frequently, by nutritionists, after a course of antibiotics, or as part of the treatment for gut related candidiasis. Claims are made that probiotics strengthen the immune system to combat allergies, excessive alcohol intake, stress, exposure to toxic substances, and other diseases. In these cases, the bacteria that work well with our bodies may decrease in number, an event which allows harmful competitors to thrive, to the detriment of our health.



Probiotic Microorganisms

Lactobacillus sp.	Bifidobacterium sp.	Other Lactic Acid Bacteria	Other Species
<i>L. acidophilus</i>	<i>B. adolescentis</i>	<i>Enterococcus faecalis</i>	<i>Bacillus cereus</i>
<i>L. casei</i>	<i>B. animalis</i>	<i>E. faecium</i>	<i>Saccharomyces boulardii</i>
<i>L. cellobiosus</i>	<i>B. longum</i>	<i>Streptococcus thermophilus</i>	
<i>L. fermentum</i>	<i>B. brevis</i>		
<i>L. lactis</i>	<i>B. bifidum</i>		
<i>L. helveticus</i>	<i>B. infantis</i>		
<i>L. reuteri</i>	<i>B. lactis</i>		
<i>L. brevis</i>			
<i>L. plantarum</i>			
<i>L. curvatus</i>			

Probiotics foods

- Miso, Cheese (soft cheeses, cottage cheeses), Kefir - A reputable fermented dairy product with many health benefits
- Sauerkraut: Besides the probiotics health benefits, sauerkraut can also fight cancer.
- Chocolate: Even chocolates now containing probiotics are available
- Tempeh: A fermented soybean with a nutty taste food from Indonesia, a popular probiotic source of food.
- Tofu and Yoghurt: Fermentation of milk with cultures of *Streptococcus thermophilus* and *Lactobacillus Bulgaricus*.

Probiotic Products in India

- **Nesvita dahi** : India's first dahi with probiotic, *Lb acidophilus*. Produced by **Nestle**
- **Danone India** - introduced its globally renowned probiotic drink- World's no.1 probiotic drink with *Lb.casei* - Produced by **Yakult**
- **Prolife** - Sugar free probiotic wellness ice cream - Produced by **Amul**
- **Probiotic lassi** - India's first specially created Low fat Diabetic Delight available in different flavours-Vanilla with chocolate sauce, Strawberry, Shahi Anjir and Chocolate - **Amul**

Probiotics incorporation in dairy products

- Ice-cream as a vehicle for delivering probiotic strains has 'great potential', giving a health boost without affecting the sensory profile of ice-cream.
- "The incorporation of probiotic bacteria into ice-creams is highly advantageous since, in addition to being a rich food from the nutritional point of view, containing dairy raw material, vitamins and minerals in its composition, it is usually consumed by everybody, being well accepted by the public."
- A scan of Mintel's New Products Database revealed that there were 35 probiotic frozen desserts launched between 2006 and summer 2008, in countries such as Spain, Ireland, Belgium, Columbia, India and China.

Non dairy probiotic beverages

Recent years-vegetarianism -common trend-developed countries-non dairy foods-increased. Vegetarian probiotic foods, by definition should be free from animal-derived ingredients. It has been suggested that fruit and vegetable juices, cereal-based foods/beverages containing microorganisms can also served as probiotics. Fruits and vegetables-healthy foods-rich in antioxidants, vitamins, dietary fibers, and minerals. Furthermore fruits and vegetables-dairy allergens that might prevent usage by certain segments of the population.

Fruit Juice Beverages with Probiotic Bacteria

- Beverage containing apple juice, banana juice, pineapple juice, blueberry juice, fructooligosaccharides and probiotic bacteria contained in vessels having a tamperproof seal.
- The probiotic bacteria are selected from the group consisting of *B. animalis (lactis)* and *L. rhamnosus* and mixtures thereof.
- When refrigerated for 36 days, the juice beverage will retain > 108 CFU/fl. oz bacteria and provide > 0.1 g/fl. oz of fructooligosaccharide.

Health Benefits of Probiotics

The consumption of probiotic products is helpful in maintaining good health, restoring body vigor, and in combating intestinal and other disease disorders. Several probiotics have reportedly shown various special therapeutic or prophylactic properties.



Different prebiotic substrates currently in commercial use

Prebiotic	Bacteria induced	Commercial name	Producing company
Lactitol	LAB and Bifidobacteria	Lactitol, Lacty	Xyrofin, (Financial) Purac
Lactulose	LAB and Bifidobacteria	Duphalac	Morinaga Milk Ind. (Japan), Bifiteralm GMBH Co. Ltd (Germany)
Inulin	Bifidobacteria	Raftiline, Fnitafit	Orafti (Belgium)Senus (Netherlands)
Fructo-oligosaccharides	Bifidobacteria	Raftilose, Actilight, Fibrulose	Orafti (Belgium)Beghin Say (France) Cosucra (Belgium)
Palatinose	Bifidobacteria	ICO/OIOS	Mitsui Sugar Co (Japan)
Raffinose	Bifidobacteria		Nippon Tensaito Co (Japan)
Soyabean oligosaccharide	LAB and Bifidobacteria	Soya Oligo	The Calps food inc.(Japan)
Lactosucrose	LAB and Bifidobacteria	Nyuka-olgo	Myashibara Co(Japan)

disease prevention. The SCFAs are quietly absorbed and can serve as an emergency source to host especially between meals.

Oligosaccharides as Prebiotics

- They are also called as bifidogenic factors, because used by bifidobacteria or other LAB's.
- It is generally made up of 2-10 monomer units
- Naturally occurring in plants and also presents in mammary secretions
- Found in certain fruits & vegetables (Banana, asparagus, garlic, wheat, tomato, onion & chicory)
- The chemical structure and chain length of prebiotic will determine how easily it can be utilized by probiotic bacteria
- Glucose terminated fructose chain with maximum chain length of 5 units give best results.

As probiotics are mainly active in the small intestine and prebiotics are only effective in the large intestine, the combination of the two may give a synergistic effect. Appropriate combinations of pre- and probiotics are **synbiotics**. Synbiotics have been defined as metabolites produced by ecoorgan or by synergistic action of prebiotics and probiotics e.g. short chain fatty acids, other fatty acids, amino acids, peptides, polyamines, carbohydrates, vitamins, numerous antioxidants and phytosterols, growth factors, coagulation factors, various signal molecules such as cytokine-like bacteriokines

The future for probiotics and prebiotics

The market for probiotic and prebiotic products will continue to grow as the knowledge of the intestinal

microflora and its role in the maintenance of health and disease resistance advances. Products like probiotic infant formulas, baby food, fermented fruit juices, fermented soy products, cereal based products as well as disease specific products are possible in future.

Probiotic Research: The research work done on prebiotics and probiotics in the Department of Foods & Nutrition are discussed here under.

Lactobacillus supplementation on immunity and morbidity status of pre-school children

Sucharitha devi.S and Yasoda devi. P (1998)

The effect of lactobacillus supplementation on immune status, diarrhoeal morbidity status and growth status of mal nourished children was studied. Results of the study showed that a dosage of lactobacillus supplementation i.e., 1.0×10^8 spores/day / child showed good immunostimulation and growth status than the higher dosage of 2.0×10^8 spores / day/ child. Shorter duration seems to be more effective i.e., 15 days of lactobacillus supplementation, than longer duration of 30, 60, and 90 days of supplementation with regard to improvement in immune status.

Supplementation of lactobacillus had significant increase on serum adenosine deaminase (ADA) an immune enzyme marker, serum total proteins and albumin levels by 15 days of supplementation when compared with control. The results on ADA showed elevated immune response after fifteen days of lactobacillus supplementation. There was slight decrease thereafter i.e., at 30 and 60 days and again it increased at 90 days of supplementation.



Probiotic supplementation on the immunity biomarkers (adenosine deaminase and zinc) of elderly

Lakshamma. G and Lakshmi Devi. N (2001)

A study was taken up to investigate the effect of Lactobacillus (L) acidophilus supplementation on the immunity biomarkers like adenosine deaminase (ADA) and Zinc(Zn) in elderly.



Lactobacillus acidophilus sachet used for supplementation



Elderly taking curds enriched with Lactobacillus acidophilus (1 gm, 10^6 CFU)

Results of the study revealed that there was no difference in mean ADA and Zn levels before and after supplementation in control group, but there was significant difference in experiment. group. Further, within the experiment. Group, ADA levels in sub-normal and normal individuals increased with supplementation and whereas in the abnormal group the ADA levels decreased indicating the immunomodulation property of L- acidophilus. Similarly, in the Zinc levels increased in experiment. group and no change was observed in control group.

It was observed that morbidity symptoms rate was significantly reduced after supplementation. Hence the probiotic supplements can be advised for the elderly who constantly suffer from minor ailments due to cessation of micro flora in the gastrointestinal tract.

Hypo Cholesterolemic effect of Lactobacillus Acidophilus supplementation

Vani.M and Yasoda Devi.P (2002)

A study was undertaken to assess the hypo cholesterolemic effect on supply of L.acidophilus in different dose and different time periods. Thirty hyper cholesterolemic subjects were selected and divided into three groups as A, B and C comprising 10 subjects in each. Group A and B were given a supplementation of 10×10^6 and 20×10^6 viable organisms/day/individual for a period of 60 days respectively. Group C served as a control group and was on medication (statins). Lipid profile (TC, TG, HDL, LDL & VLDL) was estimated before and after 30 & 60 days of supplementation.

Results of the study revealed that a dosage of L.acidophilus supplementation 20×10^6 viable organisms/day/person showed more beneficial than 10×10^6 viable organisms/day after 60 days. The lipid profiles of B group are similar to control group (medicated) indicating therapeutic value of L. acidophilus as a dietary supplement in controlling the abnormal levels of lipid profiles.

Screening of Cereals and pulses for oligosaccharide content

Sampath. S and Kondal Reddy (2005)

An attempt was made to estimate the oligosaccharide content in cereals and pulses and to study the effect of germination on different oligosaccharides (stachyose, raffinose, maltotriose, maltotetraose, maltopentaose, maltohexaose, maltoheptaose) in cereals and pulses, considering their importance as prebiotics.

In green gram (stachyose, maltohexaose), sorghum (stachyose, maltotriose), barley (stachyose, raffinose), wheat (stachyose, raffinose) and black gram (stachyose, raffinose) more than one oligosaccharide was observed.

The germination of seeds for 48 hours resulted



complete disappearance of stachyose and raffinose in cereals and pulses. The maltotriose content in pulses completely disappeared. 45.1 percent & 57.3 percent loss was observed in sorghum and maize respectively, complete loss was observed in remaining cereals.

The results suggested that the oligosaccharides present in dormant seeds were hydrolyzed during germination, which reduces the availability of prebiotic oligosaccharides. Identified rich sources of oligosaccharides are black gram, soy, cowpea and wheat, which may be used for extraction in their natural form by membrane separation. These extracted oligosaccharides can be used as prebiotics in development of functional foods.

Screening of Fruits & Vegetables for oligosaccharide content

Siddeshwar .S and Kondal Reddy (2005)

A study was done to estimate the oligosaccharide content in fruits, vegetables and roots and to find the effect of drying on different oligosaccharides (stachyose, rabinose, maltotriose, maltotetraose, maltopentaose, maltohexaose and maltoheptaose) considering their importance as prebiotics.

Forty two different samples extracted from fruits, vegetables and roots were analyzed for the presence of oligosaccharides mentioned. Mainly raffinose content was observed (mg/ g of dry matter) in ladies finger (0.089), onion (0.3015) and potato in trace amounts. In potato. More than one oligosaccharides was observed in ladies finger (raffinose, maltotetraose), onion (raffinose, maltotriose and maltotetraose) and garlic (maltotetraose, maltopentaose).

In radish, corn, pumpkin, mango, sapota, papaya, grapes, pineapple and bael fruit, oligosaccharides were not found.

All those oligosaccharides found in fresh samples were also observed in dried samples and were proportionate to the dry matter indicating that drying had no effect on enzymatic hydrolysis of complex starches to produce higher levels or different oligosaccharides in dried samples compared to fresh samples.

Carrot, ladies finger, onion, garlic, beet root, yam, guava, apple, tomato and banana appeared to be good sources for commercial extraction of prebiotics using membrane processing technology.

Effect of lactobacillus acidophilus supplementation on thiamin, riboflavin and folic acid status of rural adolescent girls.

Suneela. K and Yasoda Devi.P (2006)

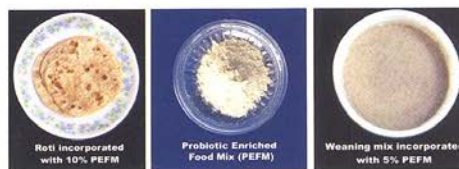
A study was undertaken to assess the effect of lactobacillus supplementation on thiamin, riboflavin and folic acid status of rural adolescent girls. The results revealed that lactobacillus supplementation at a level of 2.0×10 million viable spores / day / individual for 60 days period significantly improved the thiamine, riboflavin and folic acid status indicating nutritional value of lactobacillus as a supplement to improve the B vitamin status of rural adolescent girls.

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Probiotic enriched Non-Dairy Food Mixes

Lavanya . N and Uma Maheswari . K (2008)

A research study was carried out to develop non dairy Probiotic Enriched Food Mixes (PEFM) with staple foods. Three varieties of indigenous food mixes were prepared with bajra flour, defatted soy flour and Slimmed milk powder (SMP) in a ratio of 2:1:1 respectively. The indigenous food mixes developed were (1) Raw mix (2) Autoclaved mix (3) Probiotic Enriched Food Mix (PEFM).



The developed indigenous food mixes were assessed for nutrient composition, physico chemical characteristics and microbiological counts. Storage studies of the mixes were done for a period of two months. Two products viz. roti and weaning mix were prepared by incorporating PEFM at different levels (5% to 30%) and subjected to sensory evaluation.

The study concluded that the PEFM prepared with bajra flour, defatted soy flour and SMP in the ratio 2:1:1 has resulted in enhanced physico chemical

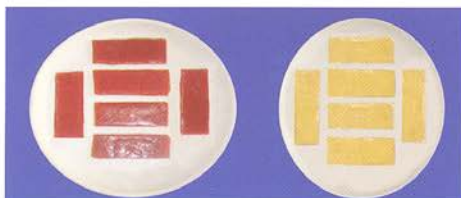


characteristics such as moisture, fat, crude fiber, Invitro protein digestivity IVPD, Invitro starch digestivity IVSD and lactobacilli counts. The developed PEFM can be incorporated to prepare acceptable food products such as roti at 20% level and weaning mix at 10% level.

Development And Evaluation Of Inulin And Fructooligosaccharides Incorporated Fruit Bars As Functional Foods

Megala. P and Hymavathy T.V. (2009)

Papaya and Banana fruit bars developed incorporating Inulin (IN) and Fructooligosaccharides (FOS) were evaluated for nutritional composition, physico-chemical characteristics and glycemic index (GI). The bars were developed and standardized with 70% of fruit pulp, 30% of sugar, 0.3% of citric acid with and without the addition of FOS and IN. In the treated bars 15% of the sugar was replaced with IN and FOS, as the mixture of them has more health benefits than singly used. Both powder form and liquid form of FOS were used in the study. Three proportions of IN and FOS viz., 90% FOS + 10% IN; 80% FOS + 20% IN and 70% FOS + 30% IN were tested for obtaining best quality of fruit bars.



Papaya bar (10% IN + 90% liquid FOS) Banana bars, 90% FOS (liquid) + 10% IN

Organoleptic evaluation of these bars revealed that among all the papaya bars, 90% FOS (Powder) + 10% IN and among banana bars, 90% FOS (liquid) + 10% IN were best accepted. The GI of control and IN & FOS treated papaya bars were estimated as 65 & 54.

The studies on development of fruit bars with IN and FOS incorporation indicated that there is a possibility of bringing down the GI of foods with incorporation of IN and FOS. With appropriate processing methods to minimize the degradation of these prebiotics or by increasing the level of incorporation the GI can be further reduced.

Food products incorporating lactobacillus sporogenes for pre-school children

Archana. D & Yasoda Devi .P (2009)

A study was taken up to check the viability of *L. sporogenes* in probiotic incorporated food products, suitable for pre- school children. *L. sporogenes* at two different dosage levels i.e. 1×10^8 spores/ gm and 2×10^8 spores/ gm were added to various recipes like Groundnut chikki, Halwa, Kichidi, Upma, Sweet biscuits, Bread, Mango jam and Mango juice. Effect of processing temperature and storage on the viability of probiotic was tested. Better probiotic viability was observed in chikki, mango jam and fresh mango juice compared to other products like halwa, kichidi and upma. Zero viability was found in bread and sweet biscuits. The viability reduced during processing from 0.39 million cfu/ gm to 0.35 million cfu/gm in chikki, 0.90 million cfu/gm to 0.84 million cfu/gm in mango jam and 0.40 million cfu/ gm to 0.39 million cfu/gm in fresh mango juice.

The study concluded that *L. sporogenes* survival rate was better with exposure to temperature of 60°C and below. The viable counts even though decreased during storage, the amount of viable probiotic available in the chikki, Mango juice and mango jam were sufficient to have health benefits in normal pre- school children.

Probiotic incorporated products in which there were viable *L. Sporogenes*



Probiotic incorporated groundnut chikki



Probiotic incorporated mango jam and mango juice



Events...

Award

Dr. Kuna Aparna, Assistant Professor (Foods & Nutrition) has received "**K G Naidu Medical Trust Award**" for best research paper titled "Effect of supplementation of *Gymnema sylvestre* leaves on blood glucose, serum lipid profile and blood pressure of newly diagnosed Type II diabetic patients" at 41st National Annual Conference of IDA, held at National Institute of Nutrition, Hyderabad held from 5th to 6th December, 2008.



International Training: Dr. Kuna Aparna has attended a three months training program in "Cutting edge areas in Agricultural Sciences – Nutraceuticals" under Dr. Peter Jones, Director at Richardson Centre For Functional Foods & Nutraceuticals (RCFFN), University of Manitoba, Winnipeg, Manitoba, Canada from January 5th to April 4th 2010. The training was sponsored under HRD program of NAIP (ICAR) under Component – 1 of Learning & Capacity Building (L & CB).

Superannuation

Dr.K.Krishana Kumari, Professor & University Head (Department of Foods & Nutrition), Director (CAFT) and Programme Director (Food Technology), Post Graduate & Research Centre, Rajendranagar had attained superannuation from her services on the 28th of February 2010.



Dr.Anurag Chaturvedi, Principal Scientist, Quality Control Cell, ANGRAU, had taken over charge as University Head (Department of Foods & Nutrition),

Dr.P.Yasoda Devi, Professor (Department of Foods & Nutrition) had taken over charge as Professor & Head (Department of Foods & Nutrition), Director (CAFT) and Programme Director (Food Technology), Post Graduate & Research Centre, Rajendranagar.



ANNOUNCEMENT



A training program on "Newer Technologies in Food processing from Production to Consumption" is tentatively scheduled by the Centre of Advanced Faculty Training, Dept. of Foods and Nutrition, Post Graduate and Research Centre from 21st July to 10th August 2010. Free Boarding and Lodging will be provided for the selected participants. The nominations of participants may be sent to the Director, CAFT.

The Food and Nutrition News is published by the Centre of Advanced Faculty Training, Department of Foods and Nutrition, College of Home Science, ANGRAU, Agricultural University. The funds for the centre are granted by the Indian Council of Agricultural Research, New Delhi.

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