

IMPLICATIONS OF DIFFERENT SPECIES AND STRAINS OF PROBIOTICS IN VARIOUS HEALTH DOMAINS- A SYSTEMATIC REVIEW

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ABSTRACT

This study has been compiled with the motive of forecasting the various species of microorganisms identified as positive probiotics in alleviating different disease conditions. It is of assumption that the probiotics are involved only in the maintenance of gastro intestinal health, but a little focus into the research studies show that there are wide range of diseases where the probiotics showcase themselves as health pioneers. Diminutive effort has been put to portray the food sources and their residence in the human body.

Key words:

Probiotics, Prebiotics, Functions, Species of microbes, Strains of probiotics

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INTRODUCTION

Probiotics are live microbes which when ingested in sufficient amounts bestow a wider health benefactions on the host. The father of probiotics, "Elie Metchnikoff" postulated that health can be toned and senescence delayed by increasing the gut microbes with host-friendly bacteria present in sour milk. The research in probiotics has taken a bloom since then and several studies conducted have supported his findings on intestinal health and has suggested many more health efficacies. Our body is a dwelling place for both supportive as well as harmful bacteria. The challenge is to maintain an optimal balance between these bacteria to ensure an unrivalled health. Age, genetics, dietary choices, temperament, sleep, drugs, and other environmental factors play a pivotal role in maintaining the body bacterial pool. A dysbiosis, in the earlier mentioned factors retards the removal of hazardous metabolic wastes such as harmful microbes, chemicals, toxins, which in turn, leads to the diseases of the gut, like Diarrhoea, Clostridium Difficile Diarrhoea (CDD), Antibiotic Associated Diarrhoea (AAD), Traveller's Diarrhoea (TD), Helicobacter Pylori Infection (HPI), Necrotizing Enterocolitis (NE), Ulcerative Colitis, Irritable Bowel Syndrome (IBS), Pouchitis, Celiac Disease, Crohn's Disease, poor gut transit and abdominal pain.

Dietary Probiotics

The traditional fermented foods which were eaten without much of processing almost a decade or two ago had proved to

be the richest source of probiotics. The relationship between probiotic consumption and the disease prevalence is also a subject of thought. Since the probiotic intake has come down for varied reasons, the number of illnesses are in increase.

The change in food consumption styles, due to transformation of life style of women has led to a striking home and work imbalance. This has made them to concentrate less on food preparations and the tendency to purchase readily available, ready to eat, ready to serve, processed and packed food products is steadily increasing. As a result of which, the intake of freshly prepared fermented food products consumption has declined. This has headed to less intake of probiotics from naturally available sources.

Yet, another reason for change in food consumption pattern is westernisation. The distance across the world has become very less, that everything is available everywhere. Increased fantasy for consuming junk foods and soft drinks has also proven to be reason for decline in probiotic intake from natural foods.

The tendency of storing food preparations for a long period of time reduces the efficacy of probiotics. For example the fermented idli or dosa batter which is the prominent probiotic source for South Indians loses its quality if stored for more than four days. Moreover, the batter purchased from shops are preserved for longer number of days by adding preservatives wherein the entire quality of probiotic is destroyed.

Hence, sticking on to our ancient food preparation and food consumption methods helps us to overcome the above predispositions and the daily probiotic intake may be enhanced without any constraints.

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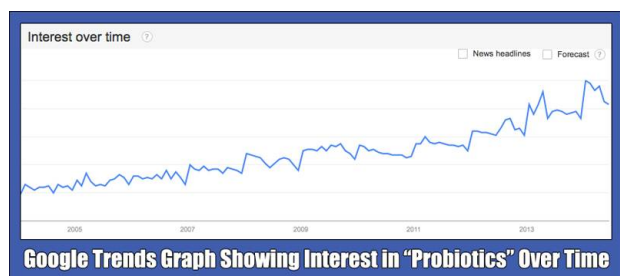
Genus / species	Strain	Function	Sources	References
Lactobacillus	L.acidophilus	<ul style="list-style-type: none"> Improves digestion and nutrient absorption Enhances the immunogenicity of mucosal and systemic vaccines Increases high density lipoprotein concentration Reduces the occurrence of acute diarrhoea and UTI in children Treatment of travellers' diarrhoea, CDD Prevents fungal infections Reduces the symptoms of IBS Improves vaginal health Treats Nonalcoholic Fatty Liver Disease in Obese Children and Adolescents 	Koozh, Lassi, yogurt, Bhatooru, marchu, chilra	Kiebling G, Schneider J, Jahreis G. <i>et al.</i> Famouri <i>et al.</i>
	L. rhamnosus	<ul style="list-style-type: none"> Reduces the percent of travellers' diarrhoea Reduces the risk of nosocomial diarrhoea and rotavirus gastroenteritis in infants Improves phagocytic ally active blood leucocytes Decreases vaginal irritation Treats vulvo-vaginal candidiasis Reduces abdominal pain, Decrease in bowel movement frequency Treats Nonalcoholic Fatty Liver Disease in Obese Children and Adolescents Reduced severe stage of NE in pre-term infants Improves immunity Reduces pancreatic necrosis and abscesses Helps in weight loss Supports intestinal barrier function Prevents IBS Prevents the production of endotoxins Has antifungal activity Lowers total and low density lipoprotein cholesterol Lowers incidence of sepsis in neonates and preterm infants Improved behavior in autistic children Improves inborn immune response Suppression of tumour development prevents colorectal cancer Increases immunoglobulin producing cells Prevents constipation Treatment of CDD Treatment of AAD in elderly Curative function in rheumatoid arthritis Treats pancreatic necrosis 	yogurt, fermented milk, pasteurized milk, and semi-hard cheese Parmigiano Reggiano cheese (Most of the dairy products)	Szajewska H , Kotowska M, Mrukowicz JZ, <i>et al</i> Gill HS, Cross ML, Rutherford KJ, <i>et al.</i> De Vrese M , Fenselau S, Feindt F, <i>et al</i> Dermyshi E <i>etal</i>
Lactobacillus	L.plantarum	<ul style="list-style-type: none"> Reduced severe stage of NE in pre-term infants Improves immunity Reduces pancreatic necrosis and abscesses Helps in weight loss Supports intestinal barrier function Prevents IBS Prevents the production of endotoxins Has antifungal activity Lowers total and low density lipoprotein cholesterol Lowers incidence of sepsis in neonates and preterm infants Improved behavior in autistic children Improves inborn immune response Suppression of tumour development prevents colorectal cancer Increases immunoglobulin producing cells Prevents constipation Treatment of CDD Treatment of AAD in elderly Curative function in rheumatoid arthritis Treats pancreatic necrosis 	Appam, Dosa, Curd, Rabdi, Babru, Enduri Pitha, Gundruk, Sinki, Ngari, Mesu, Sauerkraut, Tungtap,	Olah A, Belagyi T, Issekutz A, <i>et al.</i> Nobaek S, Johansson ML, Molin G, <i>et al.</i> Famouri <i>et al.</i> Panigrahi <i>etal</i> Glenn Gibson
	L.casei	<ul style="list-style-type: none"> Increases immunoglobulin producing cells Prevents constipation Treatment of CDD Treatment of AAD in elderly Curative function in rheumatoid arthritis Treats pancreatic necrosis 	Sour rice, Gundruk, sauerkraut, pickles, yogurt, cheese	Marteau P, Seksik P, Jian R <i>et al.</i> Pedone CA, Arnaud CC, Postaire ER, <i>et al</i>
	L.paracasei	<ul style="list-style-type: none"> Resists stomach acid and pancreatin Lowers pH of urine Enhances liver function Prevents allergic rhinitis Maintains healthy Vaginal micro flora Maintains dental health-prevents gingivitis, cavities Prevents of grouping of undesirable bacteria Reduces bacterial translocation Increases immune activity markers Increases calcium absorption in the intestine Improves IBS Prevents H. Pylori infection 	Kadi, churpa/churpi and nudu	Jahreis G, Vogelsang H, Kiessling G, <i>et al.</i> Rayes N, Seehofer D, Theruvath T, <i>et al.</i> Zajac AE, Adams AS, Turner JH <i>et al.</i>
	L.salivarius	<ul style="list-style-type: none"> Maintains dental health-prevents gingivitis, cavities Prevents of grouping of undesirable bacteria Reduces bacterial translocation Increases immune activity markers Increases calcium absorption in the intestine Improves IBS Prevents H. Pylori infection 	Naturally present in mouth and small intestine, Found in tomatoes, banana, garlic, artichoke, asparagus,	G Molin Hsieh P.S., Tsai Y.C., Chen Y.C., <i>et al.</i>
Lactobacillus	L.fermentum	<ul style="list-style-type: none"> Produces superoxide dismutase and glutathione-antioxidants which neutralize toxic end products of digestion Acts against foodborne pathogens Potential for reduction of insulin resistance Reduces hypercholesterolemia Protects from bile salt tolerance Resistant to gastric acid Reduces plague acidogenicity Decreases the incidence of vaginal dysbiosis Protects from intestinal carcinogenesis 	Dhokla, Dosa, sinki, Ambeli Haria, Jalebi, Ambali, Sourdough and kimchi	Tomaro-Duchesneau C., Saha S., Malhotra M <i>et al</i>
	L. brevis	<ul style="list-style-type: none"> Resistant to gastric acid Reduces plague acidogenicity Decreases the incidence of vaginal dysbiosis Protects from intestinal carcinogenesis 	Mesu, sinki, Yogurt. Sauerkraut. Pickles. Sourdough bread.	Suzuki S., Yakabe T., Suganuma H., <i>et al</i> Campus G., Cocco F., Carta G <i>et al</i>

	L. reuteri	<ul style="list-style-type: none"> • Reduces LDL • Supports oral health • Reduces the onset of G.I disorders in infants • Relieves infant colic 	Inhabitant of digestive tract, the female vaginal and urinary tracts, and breastmilk	Dirienzo D.B. Anabrees J., Indrio F., Paes B <i>et al.</i> Indrio F., Di Mauro A., Riezzo G <i>et al.</i>
	L.gasseri	<ul style="list-style-type: none"> • Maintains normal vaginal health • Promotes weight loss • Has anti-inflammatory effects 	Salami and chorizo, Kombucha, Kefir, yoghurt, kimchi, sauerkraut, breast milk	Yukio kadooka <i>et al.</i> Sato M,Uzu K <i>et al.</i>
	L.delbrueckii subsp.bulgaricus	<ul style="list-style-type: none"> • In elderly enhances systemic immunity • Modulates activity of brain • Lowers HbA1C levels 	Fermented milk, sour rice, Yogurt, G.I of mammals in bulgaria	Moro-García M.A., Alonso-Arias R., <i>et al</i> Qingqing Zhanget <i>al.</i>
	L.johnsonni	<ul style="list-style-type: none"> • Protects against respiratory illness • Prevents from allergic rhinitis • Reduces the risk of H. Pylori infection • Helps in metabolism of macronutrients 	Inhabitant of gut, mother's vaginal tract	Hsieh P.S., Tsai Y.C., <i>et al.</i> Lue K.H., Sun H.L. <i>et al.</i>
	B.bifidum	<ul style="list-style-type: none"> • Alleviates TD • Enhances Immunoglobulin production • Reduces NE in preterm infants • Treats Nonalcoholic Fatty Liver Disease in Obese Children and Adolescents 	Healthy colon, Breast milk, yogurt, sausage and cured meats, wine, vinegar,	Li D., Rosito G <i>et al</i> Janvier A., Malo J <i>et al</i> Famouri <i>et al</i>
	B.infantis	<ul style="list-style-type: none"> • Reduces NE in preterm infants • Reduces IBS • Regulates bowel movements • Decreases bloating • Supports normal micro flora • Helps in oligosaccharide fermentation • Improves inflammation in ulcerative colitis 	Yogurt, Cheese, gut of infants	Li D., Rosito G <i>et al</i> Janvier A., Malo J <i>et al</i> Jacobs S.E., Tobin J.M <i>et al.</i>
	B.longum	<ul style="list-style-type: none"> • Favours Detoxification • Scavenges free radicals • Improves immunity • Promotes perinatal intervention against onset of allergic sensitization • In children reduces febrile UTI • Helps in dental plaque recovery 	G.I tract, Human milk, fermented cruciferous vegetables, dried beans and cereals	Schwarzer M., Srutkova D <i>et al.</i> Di Gioia D., Aloisio I <i>et al.</i>
Bifido Bacterium	B. animalis subsp. lactis	<ul style="list-style-type: none"> • Reduces total cholesterol • Enhances phagocytic activities • Treats Nonalcoholic Fatty Liver Disease in Obese Children and Adolescents • Reduced severe stage of NE in pre-term infants • Reduces total cholesterol • Prevents NE in new born along with other Bifidobacterium sp. 	Fermented Milk, Cheese, Yogurt, G.I tract	Pinto G.S., Cenci M.S <i>et al.</i> Bordoni A., Amaretti A., <i>et al.</i> Famouri <i>et al</i> Dermyshe E <i>et al</i>
	B.breve	<ul style="list-style-type: none"> • Reduces clostridium and bacteroides concentration and maintains healthy micro flora • Stimulates antibody production • Promotes cell proliferation 	Kombucha, water kefir, and raw sauerkraut, fibre from plant sources	Bordoni A., Amaretti A., <i>et al.</i> Di Gioia D., Aloisio I <i>et al.</i> Janvier A., Malo J <i>et al</i>
	B.subtilis	<ul style="list-style-type: none"> • Suppress H.pylori infection 	Fermented soy products, kinema, tungtap, ngari	Tompkins T.A., Xu X., Ahmarani J.A. <i>et al</i>
Bacillus	B.coagulans	<ul style="list-style-type: none"> • Prevents AAD • Prevents dental caries • Stimulates nutrient absorption • Helps in treatment of vaginosis • Improves immunity • Decreases dental plaque 	Yogurt, kefir, sauerkraut, and kombucha	Hempel S., Newberry S.J., <i>et al</i> Doron S.I., Hibberd P.L., <i>et al.</i> Ratna Sudha M., Yelika K.A., <i>et al.</i> Benson K.F., Redman K.A., <i>et al.</i>
Streptococcus	S.salivarius	<ul style="list-style-type: none"> • Reduces bad breath • Lessens sore throat • Protects ear health • Reduces IBS • Inhibits proliferation of pathogenic bacteria 	In oral mucosa	David Williams
	S.thermophilus	<ul style="list-style-type: none"> • Anti-carcinogenic • Prevents ulcerative colitis • Prevents rotavirus diarrhoea • Lowers HbA1C levels 	Fermented milk products, sour rice	Wu Z.J., DU X., Zheng J. Jacobs S.E. <i>et al</i> Qingqing Zhanget <i>al.</i>
Enterococcus	E.faecium	<ul style="list-style-type: none"> • Prevents AAD 	Selroti, kinema, tungtap, Sausage, Cheese, fermented milk and meat products	Hempel S., Newberry S.J., <i>et al</i>
	E.durans	<ul style="list-style-type: none"> • Has antioxidant property • Anti-inflammatory • Accumulates selenium 	G.I tract of humans	Pieniz S., Andrezza R., <i>et al</i>

Lactococcus	L.lactis	<ul style="list-style-type: none"> • Treats AAD • Modulates brain activity 	Idli, dosa, babru, Soymilk kefir, buttermilk, curd, cheese	Johnston B.C <i>et al</i> Gao Y <i>et al</i>
Pediococcus	P. acidilactici	<ul style="list-style-type: none"> • Produces pediocin • Produces bacteriocin • Eliminates H.pylori infection • Protects from intestinal pathogens 		Kaur B., Garg N <i>et al</i> Fernandez B., <i>et al</i>
Saccharomyces	S.boulardii	<ul style="list-style-type: none"> • Improves gut barrier function • Decreases duration of diarrhoea • Prevents IBS and IBD 	Kefir, Kombucha, Litchi	Dinleyici E.C., Eren M., <i>et al</i> Shan L.S., Hou P., <i>et al</i> Choi C.H., Jo S.Y <i>et al</i>
	S.cerevisiae	<ul style="list-style-type: none"> • Improves digestibility • Delays aging • Enhances immunity 	Toddy, bread, jalebi, babru, Zutho, kudithi	Moyad
Leuconostoc	L.mesenteroides	<ul style="list-style-type: none"> • Produces Leucoin 	Fermented olives, cucumbers, sauerkraut, wine and cheese	Benmechemene Z., <i>et al</i>
Escherichia	E.coli Nissle 1917	<ul style="list-style-type: none"> • Prevention of ocular disease • Pro-inflammatory potential • Treats IBD 	Kali, inhabitant of Lower intestine	Bereswill S., Fischer A., <i>et al</i> Hsieh P.S., Tsai Y.C., <i>et al</i> Xia P <i>et al</i>

Awareness on Probiotics

Even though, the intake of probiotics through foods have come down without our knowledge due to various factors as discussed like method of preparation, storage and varied food choices it is startling that the awareness on probiotics has increased substantially over years. It is of utmost concern that the probiotics intake through food shall be encouraged rather than going for commercial supplements as the indigenous foods are always safe to consume and also inexpensive. The graph depicted below from Google trends forecasts a steady raise in the interest of people on probiotics.



The responsibility of promoting the wellness of probiotics through foods consumed on daily basis, lies on nutritionist as the interest of common man to stay healthier should be directed on the right path.

Study Criteria

The search for review included researches from 2000 to 2017. Of nearly 100s of literature collected, only fifty four studies were included. The inclusion criteria for the summarization was based on the species and strains of microbes used as probiotics, health disorders under consideration, sample size and authenticity of the results. The rest forty six studies were excluded due to repetition of datas, lack of reliability and validity of results.

The above table has been tabulated with an interest of encapsulating the functions or health impacts of different strains of different species of microbes significant as probiotic along with their sources.

Verdicts

The bacterial genera *Lactobacillus* and *Bifidobacterium*, including *Enterococcus*, *Streptococcus*, are the microbes used as probiotics commonly and are more predominant. These microbes produce lactic acid which helps maintain the acidic

pH in the gut there by enhancing the absorption of many nutrients.

It is of surprise that *Escherichia* which had been a source of food borne illness has proved to be a probiotic of great importance in human health. The fungus *Saccharomyces boulardii* obtained from litchi fruit, absent in human gut has sought attention in recent times as it accrues at normal body temperature and resists antibiotics. Hitherto, it is of great interest, when antibiotics are the sole source of treatment, in order to replace microbes depleted by antibiotics.

It is also noted that most of the studies have used a combination of strains of probiotics in treating diseases and the outcome is highly beneficial, than in studies with single strains. Certain probiotics have been a success on animal trials and need to be proved in human health.

CONCLUSION

The new arena of research on probiotics has spread its wings to show its sound implications on blood lipid profile. Some preliminary studies have shown a positive impact of probiotics on systemic diseases such as Reproductive Tract Infections, Upper Respiratory Tract Infections, Urinary Tract Infections (UTI), Oral Cavity, Non-Alcoholic Fatty Liver Disease, Obesity, Type 1 and Type 2 Diabetes and Autism. To conclude, this review has thrown a light on the various health domains where the probiotics have edged themselves, paving way for further researches in this ground.

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