

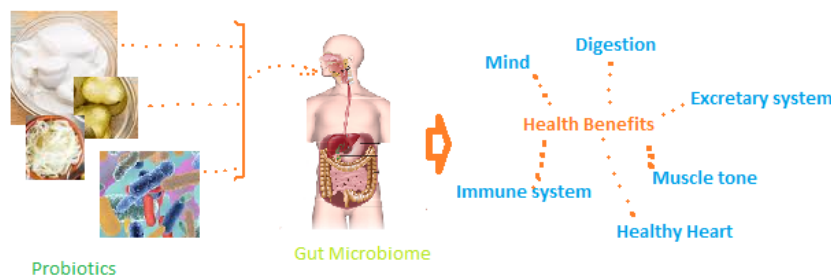
Contextual implicit role of PROBIOTICS in improving the Human Health

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Received on: 5-Aug-2017, Accepted and Published on: 22-Sept-2017

ABSTRACT



The human gastrointestinal pathway is a home of many complex ecosystems of several beneficial microorganisms. The addition of probiotics in our diet creates favourable environment for the gut microbiota. In the recently years probiotic bacteria have gained popularity as the scientific proofs support their positive impact on our health. Probiotic strains for example like Lactobacillus, Bifidobacterium are commonly used in plenty of fermented dairy and non-dairy food products. They have several health advantages like relief from bowel-related problems, increase in immunity, improved lactose intolerance and balance in the intestinal environment of microbes, cholesterol level maintenance within limits and also has a favourable effect on overall health status. There is a requirement for more research studies to further understand the role of the most efficient probiotics for other health issues. Also, extensive research is required to categorize the safety and nutritional aspects of probiotics.

Keywords: Probiotics, Microbial, Lactobacillus, Bifidobacterium, Immunity

INTRODUCTION

Food and Agriculture Organization stated “probiotics are live microorganisms having many health benefits for the host when taken in sufficient amounts”.¹ Recently the market demand for probiotics has increased at a faster pace which supports the consumption of probiotics by the consumers for their positive impact on health. Bacteria of different species are found in our gut. Out of these several varieties of microbes, bacteria which possess favourable health impact for the host are normally chosen as probiotics. These bacteria have the ability to influence the gut microbiota. It is shown that species which belong to the genera of

Lactobacillus and genera of Bifidobacterium are probiotic of beneficial effects. Probiotics are sold in market in the name of functional foods. The functional food products have resemblance to the conventional food use as far as appearance is concerned but they possess some bioactive compounds which show physiological positive health impact along with their nutritional functions.^{2,3}

“To name some of the main health effects shown by probiotics are good microflora of gut, increase in immunity, lowering of serum cholesterol, prevention of cancer, cure of irritable bowel linked to diarrhoea, lowering of blood pressure along with improved lactose metabolism”.^{4,5} Also, probiotics have been known for fat storage regulation in our body. Probiotics also influence the release of gastrointestinal hormone. They have quite good potential for nutritional as well as clinical applications.

A broad variety of food products having probiotic strains are available in the market and the number is still on increase. “The main products available commercially are dairy-based. This includes fermented milk, different types of cheese, ice cream varieties, milk powder, buttermilk and yoghurts, which accounts for the highest share in sales”.⁶ “Food applications in non dairy

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Cite as: *J. Int. Sci. Technol.*, 2017, 5(2), 50-53.

©IS Publications ISSN: 2321-4635 <http://pubs.iscience.in/jist>

components include soy-based products, nutritious bars, cereals and several juices as efficient means to deliver probiotic to the consumer".⁷ In addition, viable spores of some varieties of probiotics which form spores can be obtained at commercial level. This study is an attempt to explore all beneficial impact exerted by probiotics for health improvement, medicinal sectors and for advance lifestyle.

MECHANISM OF ACTION

After safely consuming probiotics over a long period of time in the form of dairy and non dairy fermented products have established their positive impact on our health status. Due to this the food industry has shown keen interest in probiotics for inclusion them in products. There are three major mechanisms by which probiotics function. Firstly, they have competition with potentially harmful microflora for uptake of nutrients in the digestive tract. "Any pathogenic organisms is required to attach with the GI tract epithelium to colonize in effective manner".⁸ Probiotics inhibit the adhesion of pathogens directly. "Some specific strains of Lactobacilli and bifidobacteria have the ability to attach to the epithelium wall and hence termed as "colonization barriers" by not permitting pathogens to associate with the mucosa".⁹ "This effect was illustrated with the strain Lactobacillus rhamnosus and Lactobacillus plantarum. Both these organisms possess the capacity to prevent attachment of harmful Escherichia coli to our colon cells".¹⁰ Secondly, probiotics produce anti-microorganisms substances, such as bacteriocins, organic acids, short-chain fatty acids (SCFA) and hence lowers the pH of the gut.¹¹ Bacteriocins can be defined as "compounds produced by bacteria that have biologically active protein moiety and bactericidal action".¹² Lactic acid bacteria release gas like hydrogen peroxide, and small compounds such as diacetyl, and SCFA. "The release of such compounds by the probiotics results in a change of the gut microflora".^{13,14} These factors have inhibitory effect on pathogens by making the situation opposite and this mechanism may further lead to activity loss of toxins.¹⁵ The third mechanism includes the modification of both specific and non-specific immune response. "It has been shown that probiotics have the ability to stimulate the immune response of the body. This immune response may be exhibited in the form of higher secretion of immunoglobulin-A(IgA), increased numbers of natural killer cells, or more phagocytic property of macrophages".¹⁶ Secretion of Ig A in large amounts is helpful in decreasing the number of pathogens microbes in the gut. Immunomodulating effect of probiotics has advantages in other situations such as inflammatory bowel disease and food allergy.^{17,18} This mechanism of action exhibited by probiotics is most likely to be advantageous in the prevention and cure of infectious diseases. In various other strategies, probiotics interact and modify the immune system.¹⁹

HEALTH BENEFITS OF PROBIOTICS

There are a number of research done which support the positive and beneficial effects attributed to the use of probiotics. Also, the health benefits obtained from the probiotics are strain-specific. These benefits can be discussed under various heads:

Probiotics and Diarrhoea Associated with Antibiotics

Incidence of diarrhoea either mild or severe are some commonly seen side effects of antibiotic therapy being administered. When the patient receives antibiotics during treatment of any disease, it suppresses the normal healthy microflora present in the gut, thus growth of pathogenic strains is encouraged. The appearance of symptoms may varied. "They can vary from mild symptoms of diarrhoea without mucosal abnormality to severe forms of conditions like pseudomembranous colitis. This could further lead to the delayed recovery of the patient. Several studies have shown that the probiotics when taken along with antibiotics decrease the chances of diarrhoea associated with antibiotics".^{20,21}

Probiotics and infectious diarrhoea

Probiotic microorganisms are normally added to cure and prevent diarrhoea caused by any infection. "Rotavirus is famous virus for causing acute infantile diarrhoea common in the country. This virus has a tendency to grow in the highly differentiated columnar tissues of the epithelium in small intestine. The microflora have a vital role regarding behavioural response of the host for any infection".²² "Supplementation of infant formula with appropriate probiotics can decrease the length of acute rotavirus diarrhoea".^{23,24} Probiotics namely Lactobacillus have been proven to decrease the intensity of acute diarrhoea. Probiotic therapy cut short the time period and severity of acute diarrhoea in the children.²⁵ "The mechanisms underlying the use of probiotics include decrease in growth or epithelial binding and invasion by disease producing bacteria, setting up of the barrier, and regulation of immunity. Some research have explained an inhibitory effect of probiotics against pathogens of intestine mainly through the production of bacteriocins".²⁶ The positive effects of probiotics are either dependent on strain or dose or may be both.²⁷

Probiotics and Lactose Intolerance

Lactose, a disaccharide is a constituent of two units-namely glucose and galactose. Majority of the humans possess reduced amount of lactase activity which further leads to inability to breakdown the lactose. The lactase activity level in our body is dependent on the integrity and good health of the gut. Because of this celiac patient usually develops symptoms like that of lactose intolerance. Lactose intolerance is also caused due to genetic factor. It is inability of our body to digest lactose and form units of glucose and galactose. In this situation, the lactose crosses and reaches unchanged to the large bowel where it is acted upon by enzymes present in bacteria. This causes osmotic diarrhoea. Fermented milk products are helpful in alleviating the symptoms of diarrhoea as they increase the time of gastric emptying. The viscosity of fermented products is greater than milk. This delay help to hydrolyse the lactose much before it reaches the colon. These research findings also support that pasteurized yoghurt containing probiotics is helpful in decreasing the symptoms.²⁸ "It is well known that the bacteria strains used as starter culture in yoghurt (*S thermophilus* and *Lactobacillus delbrueckii* subspecies *bulgaricus*) help in lactose digestion".²⁹ "From the number of studies, it is concluded that problem of lactose intolerance can be eliminated by regular intake of the fermented dairy products as

they release beta-galactosidase enzyme with the use of lactic acid bacteria found in them".³⁰

Probiotics and Allergy

Recently allergic diseases are becoming more common worldwide and they present a burden on society, both physically and socially. Allergies in our body occur due to the immune system reaction in response to outside harmless particles. Probiotics help to cure allergies by undoing the destruction caused to digestive tract and thus help to decrease the inflammation of gut. They aid in strengthening of the gut lining. "Probiotics tend to modify the structure of antigens, reduce the immunogenicity, enhance the permeability of intestine and increase the production of pro-inflammatory cytokines that are found in patients with several allergic disorder".³¹ However, for understanding the role of probiotics in allergy more investigation is required to know about the optimal strains, dose, timing, and time period of their use.

Probiotics and Urogenital infections

Urogenital infections are common problem that affect women. In spite of antimicrobial therapy used for treatment of these problems, there are chances of their recurrence. Clinically the evidence suggests role of urogenital microbial flora in maintaining the health of women. Urogenital infection is caused mainly due to modification in the vaginal environment. There is decrease in urogenital infection incidence if strength of lactobacilli reduces in a vaginal environment. Because of this decline, there is a decrease in protection against pathogens. Lactobacilli have competition with other strains of pathogens for the nutrients and also space adherence on the vaginal epithelium walls, urinary bladder surface and vaginal path cells. "Lactobacilli releases biosurfactants and few proteins for making binding protein that stop pathogen adhesion".³²

Probiotics and Immunity

"Entry of any foreign particle in the body leads to the initiation of immune response by the innate immunity. Innate immunity comes to the rescue and have important role in maintaining homeostasis of the host in part by helping adaptive immune responses against inflammation caused".³³ But imbalance in the immune response might cause inflammation and damage to the tissues. Intestinal microbiota has a crucial role to play in intestinal homeostasis maintenance and induction of systemic responses. "Many of these responses are due to probiotic stimulation of particular intracellular signalling pathways of the epithelial cells. The immunological advantages of probiotics may be because of activation of local macrophages and change in IgA production".³⁴

Probiotics and Blood Cholesterol

Consumption of fermented products over long period of time are linked with higher values in good cholesterol named high-density lipoprotein.³⁵ The exact way how probiotics are important in controlling cholesterol values in blood is incompletely understood. "However, a range of mechanisms are assimilation of cholesterol by bacterial cells, deconjugation of bile acids, excretion of cholesterol in large amounts, reducing of synthesis of cholesterol and redistribution of cholesterol from plasma to the liver".³⁶ Extensive research is required for identification of

several responses pertaining to the probiotics effect on metabolism of lipids.

Probiotics and Oral Health

Probiotics influence oral health by associating with oral microbiome. The constitution of person's microbiome affects the health status, which is a factor affecting the oral health. Probiotics are helpful in reducing the extent of the inflammation found in the oral cavity. Along with this, probiotics are helpful in destruction of oral cavity pathogens. "Lactobacillus acidophilus and Bifidobacterium lactis have been known to have antifungal property".³⁷ "Numerous clinical research studies have given results which indicate the positive effects of the regular probiotic yoghurt intake on decreasing the numbers of cariogenic streptococci in the oral cavity in both saliva and dental plaque".³⁸ As the use of probiotics is considered to be natural treatment it does not possess any side effects.

Other Health Effects

The health effects of probiotics not only include the benefits mentioned above. In fact the list of benefits is much more. There is enough proof that bacteria present in probiotics may have important role in reducing cancer incidence. "The studies have illustrated that some specific species of Lactobacillus and Bifidobacterium species reduce the amount of carcinogenic enzymes released by colonic flora through normalization of intestinal permeability and microflora balance along with production of antimutagenic organic acids and betterment of host's immune system".³⁹

In addition, probiotics are used in the curing chronic liver diseases as they stop the entry of pathogens microbes into blood supply and to the ultimately to liver by maintaining the health of the intestinal barrier.⁴⁰ Probiotics have some physiological role that can be useful in fighting overweight and obesity.

CONCLUSION

The health benefits of probiotics extends beyond the list included in this paper. It includes a broad range of results from several research studies but still they require further verification by human studies. There is enough evidence to prove that probiotics have a positive role in lactose intolerance, diarrhoea associated with antibiotics and diarrhoea resulting from infections, and various types of allergy. In addition to this, there is growing evidence about their involvement in several other health problems. In the past few years the probiotics are in high demand as people have recognized their potential health advantages. As a result, there are plenty of probiotic products available in the market. Consumers normally prefer yoghurt as a source of probiotic bacteria. Even today probiotic development requires lot of innovation research. Efforts are required to know about the exact dosage of probiotics to be used in various health problems for their therapeutic use.

REFERENCES AND NOTES

1. M.E. Sanders. Probiotics: Considerations for human health. *Nutr. Rev.* **2003**, 61 (3), 91–99.
2. Stanton, Emms, Sia. Malaysia's Markets for Functional Foods, Nutraceuticals and Organic Foods: *Agric. Agri-Food Canada* **2011**, No.

- March, 1–38.
3. M. Arora, S. Sharma, A. Baldi. Comparative Insight of Regulatory Guidelines for Probiotics in USA, India and Malaysia: A Critical Review. *Int. J. Biotechnol. Wellness Ind.* **2013**, 2 (2), 51–64.
 4. M. Saarela, G. Mogensen, R. Fondén, J. Mättö, T. Mattila-Sandholm. Probiotic bacteria: Safety, functional and technological properties. *J. Biotechnol.* **2000**, 84 (3), 197–215.
 5. R. Nagpal, A. Kumar, M. Kumar, et al. Probiotics, their health benefits and applications for developing healthier foods: A review. *FEMS Microbiol. Lett.* **2012**, 334 (1), 1–15.
 6. C. Stanton, G. Gardiner, H. Meehan, et al. Market potential for probiotics. *Am. J. Clin. Nutr.* **2001**, 73 (2 SUPPL.).
 7. J.A. Ewe, W.N. Wan-Abdullah, M.T. Liang. Viability and growth characteristics of Lactobacillus in soymilk supplemented with B-vitamins. *Int. J. Food Sci. Nutr.* **2010**, 61 (1), 87–107.
 8. R. Fuller. Probiotics in human medicine. *Gut* **1991**, 32 (4), 439–442.
 9. R. Fuller, G.R. Gibson. Modification of the intestinal microflora using probiotics and prebiotics. *Scand. J. Gastroenterol. Suppl.* **1997**, 32 (222), 28–31.
 10. D.R. Mack, S. Michail, S. Wei, L. McDougall, M.A. Hollingsworth. Probiotics inhibit enteropathogenic E. coli adherence in vitro by inducing intestinal mucin gene expression. *Am. J. Physiol. - Gastrointest. Liver Physiol.* **1999**, 276 (4 39-4).
 11. R.D. Rolfe. The role of probiotic cultures in the control of gastrointestinal health. *J. Nutr.* **2000**, 130 (2 SUPPL.).
 12. B.J. Juven, R.J. Meinersmann, N.J. Stern. A Review: Antagonistic effects of lactobacilli and pediococci to control intestinal colonization by human enteropathogens in live poultry. *J. Appl. Bacteriol.* **1991**, 70 (2), 95–103.
 13. S.A. Belorkar, A.K. Gupta, A.C. Aprotosoai, et al. Dietary prebiotics: current status and new definition. *Trends Food Sci. Technol.* **2014**, 21 (2), 89–94.
 14. C. Mishra. Production of anti-microbial substances by probiotics. *Asia Pac. J. Clin. Nutr.* **1996**, 5 (1), 20–24.
 15. P. Lakra, I. Nashier Gahlawat. Prospective Phytochemicals for alleviation of different chronic ailments. *Integr. J. Soc. Sci.* **2015**, 2 (1), 36–39.
 16. E.J. Schiffrin, F. Rochat, H. Link-Amster, J.M. Aeschlimann, A. Donnet-Hughes. Immunomodulation of Human Blood Cells Following the Ingestion of Lactic Acid Bacteria. *J. Dairy Sci.* **1995**, 78 (3), 491–497.
 17. M. Schultz, R.B. Sartor. Probiotics and inflammatory bowel diseases. *Am. J. Gastroenterol.* **2000**, 95 (1 SUPPL.).
 18. E. Miele, F. Pascarella, E. Giannetti, et al. Effect of a probiotic preparation (VSL#3) on induction and maintenance of remission in children with ulcerative colitis. *Am. J. Gastroenterol.* **2009**, 104 (2), 437–443.
 19. R. de P.F. Guiné, A.C.F. Silva. Probiotics, prebiotics and synbiotics. *Funct. Foods Sources, Heal. Eff. Futur. Perspect.* **2016**, 143–207.
 20. S. Sazawal, G. Hiremath, U. Dhingra, et al. Efficacy of probiotics in prevention of acute diarrhoea: a meta-analysis of masked, randomised, placebo-controlled trials. *Lancet Infect. Dis.* **2006**, 6 (6), 374–382.
 21. S.J. Allen, K. Wareham, D. Wang, et al. Lactobacilli and bifidobacteria in the prevention of antibiotic-associated diarrhoea and Clostridium difficile diarrhoea in older inpatients (PLACIDE): a randomised, double-blind, placebo-controlled, multicentre trial. *Lancet* **2013**, 382 (9900), 1249–1257.
 22. A. Darragh, S. Salminen, P. Moughan, et al. Functional food science and gastrointestinal physiology and function. *Br. J. Nutr.* **1998**, 80 (1), S147–S171.
 23. P.S. Nagendra. Functional cultures and health benefits. *Int. Dairy J.* **2007**, 17, 1262–1277.
 24. S. H., M. J.Z. Probiotics in the treatment and prevention of acute infectious diarrhea in infants and children: A systematic review of published randomized, double-blind, placebo-controlled trials. *J. Pediatr. Gastroenterol. Nutr.* **2001**, 33 (4 SUPPL.), S17–S25.
 25. J.S. Huang, A. Bousvaros, J.W. Lee, A. Diaz, E.J. Davidson. Efficacy of probiotic use in acute diarrhea in children: A meta-analysis. *Dig. Dis. Sci.* **2002**, 47 (11), 2625–2634.
 26. S. Moslehi-Jenabian, D.S. Nielsen, L. Jespersen. Application of molecular biology and genomics of probiotics for enteric cytoprotection. *Probiotic Bact. Enteric Infect. Cytoprot. by Probiotic Bact.* **2011**, 133–153.
 27. M. Mikov, M. Stojancevic, G. Bojic. Probiotics as a promising treatment for inflammatory bowel disease. *Hosp. Pharmacol. - Int. Multidiscip. J.* **2014**, 1 (1), 52–60.
 28. M. De Vrese, A. Stegelmann, B. Richter, S. Fenselau, C. Laue. Probiotics—compensation for lactase insufficiency 1–3. *Am J Clin Nutr* **2018**, 73 (February), 421–429.
 29. S.M. Bonanome, Andrea; Grundy. Yogurt—an autodigesting source of lactose. *N. Engl. J. Med.* **1988**, 1244–1248.
 30. J. Li, W. Zhang, C. Wang, et al. Lactococcus lactis expressing food-grade β-galactosidase alleviates lactose intolerance symptoms in post-weaning Balb/c mice. *Appl. Microbiol. Biotechnol.* **2012**, 96 (6), 1499–1506.
 31. R.S. Gowri, P. Meenambigai, P. Prabhavathi, P. Raja Rajeswari, L.A. Yesudoss. Probiotics and its Effects on Human Health-A Review. *Int. J. Curr. Microbiol. Appl. Sci.* **2016**, 5 (4), 384–392.
 32. C. Heinemann, J.E.T. Van Hylckama Vlieg, D.B. Janssen, et al. Purification and characterization of a surface-binding protein from Lactobacillus fermentum RC-14 that inhibits adhesion of Enterococcus faecalis 1131. *FEMS Microbiol. Lett.* **2000**, 190 (1), 177–180.
 33. P. Lakra, I. Nashier Gahlawat. The role of Nutrition in the Immune system functions. *Integr. J. Soc. Sci.* **2016**, 3 (1), 30–33.
 34. J. Kabeerdoss, R. Shobana Devi, R. Regina Mary, et al. Effect of yoghurt containing Bifidobacterium lactis Bb12® on faecal excretion of secretory immunoglobulin A and human beta-defensin 2 in healthy adult volunteers. *Nutr. J.* **2011**, 10 (1).
 35. M. Kawase, H. Hashimoto, M. Hosoda, H. Morita, A. Hosono. Effect of administration of fermented milk containing whey protein concentrate to rats and healthy men on serum lipids and blood pressure. *J. Dairy Sci.* **2000**, 83 (2), 255–263.
 36. H.S. Gill, F. Guarner. Probiotics and human health: A clinical perspective. *Postgrad. Med. J.* **2004**, 80 (947), 516–526.
 37. S. KS. Safety concerns of Probiotic use: A review. *IOSR J. Dent. Med. Sci.* **2013**, 12 (1), 56–60.
 38. E. Montero, M. Iniesta, S. Roldán, D. Herrera. Probiotics and oral health. *Probiotics Child.* **2016**, 135–160.
 39. M. Singh, V. Kumar, I. Singh, V. Gauttam, A.N. Kalia. Anti-inflammatory activity of aqueous extract of Mirabilis jalapa Linn. leaves. *Pharmacognosy Res.* **2010**, 2 (6), 364–367.
 40. C. Cesaro, A. Tiso, A. Del Prete, et al. Gut microbiota and probiotics in chronic liver diseases. *Dig. Liver Dis.* **2011**, 43 (6), 431–438.