

Probiotics: A Therapeutic Boon for the Elderly Population

Smiline Girija AS^{1*}, Sakthi Dasan S^{2**}, Dinakaran N^{3**}, Natarajan VS^{4**}

Abstract

Aging is associated with increased susceptibility to degeneration or infectious diseases, which may be aggravated by a poor nutritional status. The changes in the gut microbiota composition with ageing are being related to the progression of disease and frailty in elderly population. Studies in the elderly describe a shift in the composition of intestinal microbiota, with a lower number of beneficial organisms such as *Bifidobacteria* and *Lactobacillus* and an increase in *Enterobacteriaceae* and certain *Proteobacteria*. Recent studies have also reported a greater inter individual variation among elderly and a significant relationship between gut microbiota, diet and institution or community living. Hence it is hypothesized that the maintenance of a healthy gut microbiota during ageing could help in promoting healthy ageing.

Key words: Probiotics, old age, *Lactobacilli*, *Bifidobacterium*

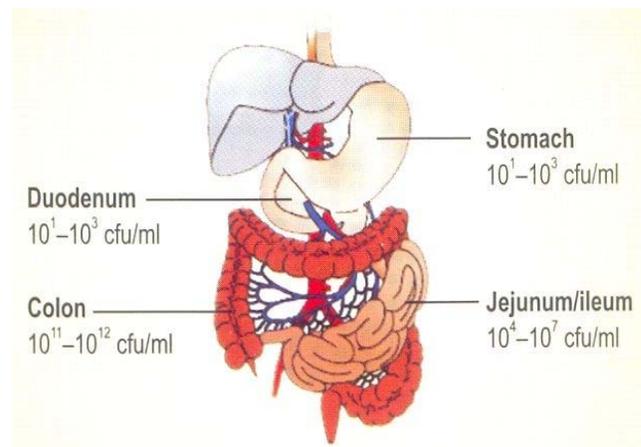
(*Journal of The Indian Academy of Geriatrics, 2015; 11:78-81*)

Role of probiotics in old age

Probiotics can be considered as the “little magical bullets” which when bombarded in adequate doses into the live tissues explores their broad spectrum bioactivity. Each probiotic varies in its unique characteristics and effects. Several species of *Lactobacillus*, *Bifidobacterium*, *Streptococcus*, yeasts and molds serve as novel fountain of healthy life in old age. Probiotics according to present day interpretation refers to viable micro-organism that promotes or support a beneficial

balance of the autochthonous microbial population of the gastrointestinal tract. Dr. Metchnikoff's accurate description of vital elements in the body's intestinal flora is equally important along with his discovery of phagocytes and other immune system component. Composition of gut microbiota consists of major microbial flora such as *Bacteroides*, *Firmicutes*, *Fusobacteria* and *Actinobacteria*.

Human gut microbiota



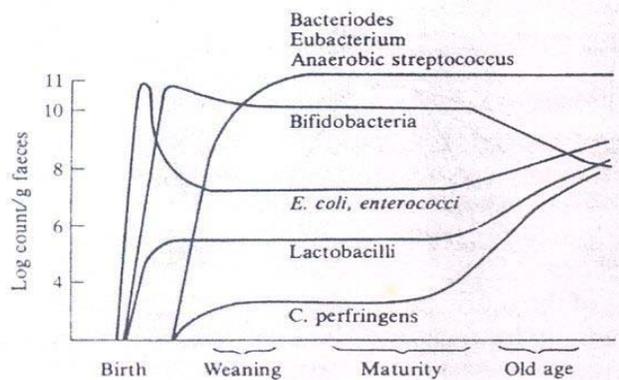
¹Reader, Department of Microbiology; ²Associate Professor, Department of Biochemistry; ³Department of Medical Gastroenterology; ⁴Visiting Senior Geriatric Physician

*Meenakshi Ammal Dental College and Hospital, MAHER, Meenakshi University, Madhuravoyal, Chennai – 600 095, Tamilnadu, India

** Melmaruvathur Adhiparasakthi Institute of Medical Sciences and Research, Melmaruvathur-603319, Tamilnadu, India

Corresponding Author: Smiline Girija AS, Reader, Meenakshi Ammal Dental College and Hospital, MAHER, Meenakshi University, Madhuravoyal, Chennai – 600 095, Tamilnadu, India

Concentration of Probiotics on ageing



Target health benefit 1. Resistant to enteric pathogen, 2. Urogenital infection, 3. Infection caused by *Helicobacter pylori*, 4. Anti-colon cancer effect, 5. Antihypertensive

Probiotics role in waning of immunity

The known fact of metabolic disorders, communicable and non-communicable diseases in elderly people can be directly linked with the decreased function of the immune system. Reduction of secretory IgA, defensins and gastric acids leads to improper local immunity. The depletion of phagocytic cells and B lymphocytes compromises the fact of imperfect antibody diversity and antibody affinity in elderly people.¹ For example, in the innate immune function, administration of probiotics improves the phagocytic property of peripheral blood leucocytes and other granulocytes.² Significant increase in the receptor expression, the phagocytic index, oxidative burst and NK cell function have also been implemented in old age upon probiotic supplementation.³ In the acquired immune response, significant rise in the production of IgG, IgA and IgM have also been studied in old age upon probiotic intervention.⁴ In terms of local immune response it enhances the gut barrier function and improves local immunity. Probiotics also elevates the cytokine production such as IL-1, IL-2, IL-6, IL-10, IL-12, IL-18, TNF, IFN etc.⁵ The direct effect of the gut microbial flora have a significant effect on the old age immune system and if altered with an overuse of antibiotics, they may be prone to autoimmune-related diseases, inflammatory bowel disease, and type 1 diabetes.⁶

Probiotics role in aging intestines

The mucosal architecture in old age does not reveal any functional or structural deterioration under normal condition due to the increased small

bowel enterocyte proliferation and apoptosis and is thus maintained. However, it has been reported that hyper proliferation and exaggerated apoptosis can result in cellular immaturity in old age due to stress and other infectious factors. This results in impaired absorptive function.⁷ Also the changes in the intestinal microbiota shift the composition of pathogenic organisms in more numbers with depletion in the commensals. This change in microbiota and intestinal transit period in due course results in putrefaction of colon leading to greater susceptibility to diseases and induces a subclinical intestinal inflammation.⁸ Small bowel bacterial overgrowth has been in association with nutritional malabsorption and diarrhoea with subsequent loss in weight and intestinal mucosal changes.⁹ Other factors of malabsorption include poor dentition or decaying teeth, dysphagia, and functional visual and cognitive impairment.

Probiotics/synbiotics have been demonstrated to increase the mineral absorption particularly that of calcium and magnesium. The underlying mechanism behind the increased solubility of minerals is that the probiotics produce many short chain fatty acids and the enlargement of absorption surface is promoted by the bacterial fermentation products like lactate and butyrate.¹⁰ Probiotics also aids in the expression of calcium binding proteins. The gut health is highly improved by the degradation of the mineral complexing phytic acid. Also they stabilise the intestinal flora and ecology. Supplementation of the probiotics influences the colonic bacteria and increases certain vital or beneficial bacterial population like *Bifidobacterium* that could alleviate the lactose intolerance systems. It also reduces the risks of infection.¹¹ An interesting fact about the probiotics is that they play a promising role in the control of *C. difficile* associated diarrhoea, ulcerative colitis, irritable bowel syndrome, pouchitis and radiation associated enteritis.¹² They also increases anti-inflammatory cytokines, and decreases the pro-inflammatory cytokines and thus modifies and regulates the overall gut inflammatory mechanisms.¹³

Probiotics and bone health

Reduction in the calcium absorption occurs in old age due to depletion of enterocyte vitamin D receptors.¹⁴ The skeletal system is also prone to infections resulting in arthritis and other inflammatory conditions.¹⁵ Probiotics were known for assisting increased calcium absorption by making inulin type fructans and other promising substances that could help to improve the supply with available calcium and thus contributes to bone health.¹⁶

Probiotics in old age neurodegeneration

The actual fact associated with the enteric dysfunction in old age is mainly due to the degeneration of the enteric nervous system with the submucosal and myenteric plexus neuronal loss.¹⁷ Also it has been reported that there is a selective degeneration of cholinergic neurons and interstitial cells. Also the enteric glia has also depleted with the distal gut being more severely affected which subsequently leads to functional problems like constipation, incontinence and evacuation.¹⁸

Probiotics in the control of RTI

Upper respiratory tract infection that includes the common cold, inflammation of the trachea and larynx seems to be one of the most common infections in old age. Most acute upper RTI are caused by viruses and usually resolve in 3 – 7 days. Though there are no supporting research works for the control of RTI with probiotics, it has been suggestive that they can confer the health benefit to the patient if administered in adequate doses. However animal studies in mice have shown that the administration of Bifidobacterium augmented with IgG confers protection against influenza viruses.¹⁹ Thus it needs a complete research to understand the facts of the beneficial role of probiotics in the control of RTI.

Probiotics role in the control of UTI

The changes in the urinary epithelial lining, poor function of the renal systems often propels the old age towards the occurrence of various urinary tract infections. The administration of probiotics in the affected individuals has been found to reduce the recurrent UTI infection and the induction of drug resistance has also been inhibited.

Probiotics in carcinogenic transformation

Implication of enterocyte hyperproliferation and decreased apoptosis in the colon has been the potential cause for carcinogenic proliferation in elderly people.²⁰ Also an increased activity of epithelial growth factor receptor [EGFR] could be the major fact for the aging in the colonic mucosa.²¹ The administration of the prebiotic and synbiotics stimulates the growth of the beneficial bacteria and inhibit the development of aberrant crypt foci in the colonic mucosa suggesting the tumour inhibiting property of chicory fructans. Studies related with animal trials reduce the colonic mucosal proliferation and decreases the activities of tumour ornithine decarboxylase and other ras p-21.²² Also the fermentation products and short chain fatty

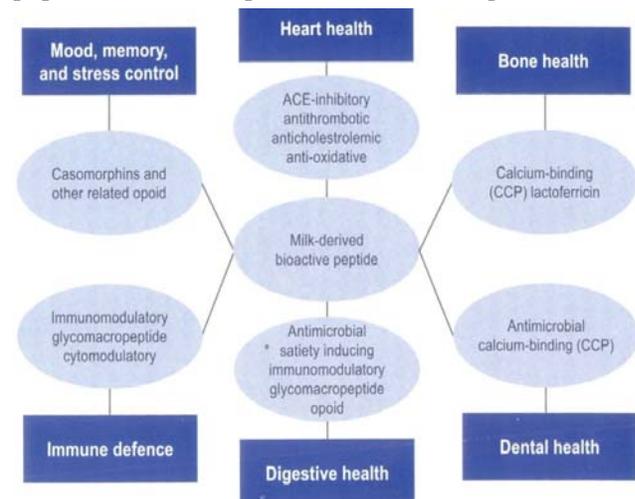
acids like butyrate and propionate inhibits the growth of colon tumour cells and histone deacetylases. Butyrate from probiotics causes apoptosis, reduces metastasis in colon cell lines and protects the body from genotoxic carcinogens with the enhancement of expressing enzymes involved in detoxification. The preventive effect of probiotic *Lactobacilli* has also been studied against superficial bladder cancers.²³

Probiotics in oral cavity

Supplementation of probiotics in this elderly group produces acids and other anti-microbial products or by interference on the mucosal immunity modulates IgA synthesis and mucus production. Also studies confer that there is a significant reduction in the amounts of yeasts in the oral cavity suggesting a therapeutic ability of the probiotics in the oro-dental infections.²⁴

Clinical applications of probiotics in geriatric patients

Functionality of milk protein-derived bioactive peptides and their potential health targets



Conclusion

Probiotics and future

To conclude, probiotics in future would play an intriguing role in the control of major gastrointestinal disorders and also non-GIT disorders like obesity, diabetes mellitus and metabolic syndrome. Genetically modified probiotics providing epitopes for vaccine delivery is a field of fascination to improve the immune response in old population. Major disorders like *C. difficile* associated diarrhoea, irritable bowel syndrome, increased insulin sensitivity are major exciting areas of research.

Probiotic has got wider range of application and implication in geriatric patients.

References

1. Weiskopf D, Weinberger B and Grubeck-Loebenstein B. Theaging of the immune system. *Transpl Int* 2009; 22:1041–50.
2. Butcher S, Chahel H and Lord JM. Ageing and the neutrophil: noappetite for killing? *Immunology* 2000; 100:411–6.
3. Ligthart GJ, Schuit HR and Hijmans W. Natural killer cell function is not diminished in the healthy aged and is proportional to the number of NK cells in the peripheral blood. *Immunology* 1989; 68:396–402.
4. Gill HS, Rutherford KJ, Prasad J and Gopal PK. Enhancement of natural and acquired immunity by *Lactobacillus rhamnosus* (HN001), *Lactobacillus acidophilus* (HN017) and *Bifidobacterium lactis* (HN019). *Br J Nutr* 2000; 83:167–76.
5. Schiffrin EJ, Brassart D, Servin AL, Rochat F and Donnet-Hughes A. Immune modulation of blood leukocytes in humans by lactic acid bacteria: criteria for strain selection. *Am J Clin Nutr* 1997; 66(suppl): 515S–20S.
6. Arunachalam K, Gill HS and Chandra RK. Enhancement of natural immune function by dietary consumption of *Bifidobacterium lactis* (HN019). *Eur J Clin Nutr* 2000;54:1–5.
7. Claesson MJ, Cusack S and O’Sullivan O et al. Composition, variability, and temporal stability of the intestinal microbiota of the elderly. *Proc Natl Acad Sci USA* 2011; 108:
8. Hebuterne X. Gut changes attributed to ageing: effects on intestinal microflora. *Curr Opin Clin Nutr Metab Care*2003;6:49–54.
9. Mitsui T, Shimaoka K, Goto Y, Kagami H, Kinomoto H, Ito A and Kondo T. Small bowel bacterial over growth is not seen in healthy adults but is in disabled older adults. *Hepato gastroenterology* 2006; 53:82-5.
10. Cummings JH, Macfarlane GT and Englyst HN. Prebiotic digestion and fermentation. *Am J Clin Nutr* 2001 Feb; 73 (2 Suppl): 415S-420S.
11. Delcenserie, D. Martel, M. Lamoureux, J. Amiot, Y. Boutin, and D. Roy. Immunomodulatory Effects of Probiotics in the Intestinal Tract *Curr. Issues Mol. Biol.* 2007;10: 37-54.
12. Sazawal S, Hiremath G, Dhingra U, Malik P, Deb S and BlackRE. Efficacy of probiotics in prevention of acute diarrhoea: ameta-analysis of masked, randomised, placebo-controlled trials. *Lancet Infect Dis* 2006; 6: 374–82.
13. Guigoz Y, Doré J and Schiffrin EJ. The inflammatory status of old age can be nurtured from the intestinal environment. *Curr Opin Clin Nutr Metab Care* 2008; 11: 13–20.
14. Ebeling PR, Sandgren ME, DiMagno EP, Lane AW, DeLuca HF and Riggs BL. Evidence of an age related decrease in intestinal responsiveness to vitamin D: relationship between serum 1,25-dihydroxyvitamin D3 and intestinal vitamin D receptor concentrations in normal women. *J Clin Endocrinol Metab* 1992; 75: 176-82.
15. Scholz-Ahrens KE, Ade P, Marten B, Weber P, Timm W and Açil Y, et al. Prebiotics, probiotics, and synbiotics affect mineral absorption, bone mineral content, and bone structure. *J Nutr* 2007; 137(3 Suppl. 2):838-46S.
16. Nordin BE, Need AG, Morris HA, O’Loughlin PD and Horowitz M. Effect of age on calcium absorption in postmenopausal women. *Am J Clin Nutr* 2004; 80:998-1002.
17. Camilleri M, Cowen T, Koch TR. Enteric neurodegeneration in ageing. *Neurogastroenterol Motil* 2008; 20(4); 418-429
18. Wiskur B and Greenwood-Van Meerveld B. The aging colon: the role of enteric neuro degeneration in constipation. *Curr Gastroenterol Rep* 2010;12:507-12.
19. Qiukui Hao, Zhenchan Lu, Bi Rong Dong, Chang Quan Huang and Taixiang Wu. Probiotics for preventing acute upper respiratory tract Infections. *Cochrane Database of Systematic Reviews* 2011, Issue 9. Pages 1 -30.
20. Xiao ZQ, Moragoda L, Jaszewski R, Hatfield JA, Fligiell SE and Majumdar AP. Aging is associated with increased proliferation and decreased apoptosis in the colonic mucosa. *Mech Ageing Dev* 2001; 122:1849-64.
21. Schmelz EM, Levi E, Du J, Xu H and Majumdar AP. Age-related loss of EGF-receptor related protein (ERRP) in the aging colon is a potential risk factor for coloncancer. *Mech Ageing Dev* 2004;125:917-22.
22. Majumdar AP, Du J, Yu Y, Xu H, Levi E and Patel BB, et al. Cell cycle and apoptosis regulatory protein-1: a novel regulator of apoptosis in the colonicmucosa during aging. *Am J Physiol Gastrointest Liver Physiol* 2007; 293: G1215-22.
23. Aso Y, Akazan H, Kotake T, Tsukamoto T, Imai K and Naito S. Preventative effect of a *Lactobacillus casei* preparation on the recurrence of superficial bladder cancer in a double-blind trial. *Eur Urol* 1995; 27:104–9.
24. Fabio Henrique, Silvana Soléo, Ivan da Silva and Mariella Vieira. Effects of Probiotic Bacteria on Candida Presence and IgA Anti-Candida in the Oral Cavity of Elderly. *Braz Dent J* 2012; 23(5): 534-538