RESEARCH PAPER | HOME SCIENCE | Volume : 5 | Issue : 4 | April 2015 | ISSN - 2249-555X

Prebiotics in Health

KEYWORDS: prebiotics, health, production,sources

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ABSTRACT *Prebiotics are selectively fermented ingredients that allow specific changes, both in the composition and/ or activity in the gastrointestinal microbiota that confers benefits upon host well-being and health. Studies suggest that they reduce the risk of obesity by promoting satiety and weight loss. Prebiotics increases the bioavailability and uptake of,food minerals. Additional research is needed to define the relationship between the consumption of different prebiotics and improvement of human health has to be explored. The knowledge on recent trends in prebiotic production from new novel sources, from food industrial wastes, prebiotic supplementation in food, commercially available prebiotic agents, prebiotic production by various techniques and future perspectives should be well understood to use prebiotics to improve our health. Understanding of the effects of prebiotics on health and disease could assist in surmounting regulatory issues related to prebiotic use.*

INTRODUCTION:

A prebiotic is defined as a selectively fermented ingredient that allows specific changes, both in the composition and/ or activity in the gastrointestinal microflora that confers benefits 1. Prebiotics are often refered to as colonic nutrient and colonic microflora is found to have a profound influence on health2. Prebiotics can be classified based on certain criteria. Fructooligosaccharides (FOS), inulin, galactooligosaccharides (GOS), lactulose and polydextrose can be classified as the most established prebiotics. Emerging prebiotics include xylooligosaccahrides (XOS) isomaltooligosaccharides (IMO) and lactitol. Industrial applications of inulin from chicory root (FOS), arabinoxylooligosaccharides (AXOS) and xylooligosaccharides (XOS) are also recognized especially in food industries.3,4,5,6. Whole grains rich in resistant starch-rich have shown prebiotic characteristics and is believed to exert beneficial health effects. There is currently a great deal of interest in the use of prebiotic as functional food ingredients to manipulate the composition of colonic microflora in order to improve health 7,8,9,10,11

Role of prebiotics in health

Gut health maintainence

Gut microbiota is considered as a key element in health and well being. Gut microflora plays an important nutritional and physiopathological role such as prevention of gut colonization of potentially pathogenic microorganisms, source of energy for the cells of the gut wall, modulation of the immune system, modulation of gene expression and cell differentiation in the gut wall. Gut microflora management through diet can be done through the use of prebiotics, which are directed at present towards genus level changes in the gut microbiota composition.. Prebiotic intake can modulate immune parameters of gut associated lymphoid tissues and peripheral circulation 12. Administration of inulin and oligofructose in adequate amount promote the growth of bifidobacteria and findings have suggested it brings about significant improvement in infants with necrotizing enterocolitis (NEC) which is a predominant factor contributing to morbidity and mortality in premature infants. Addition of prebiotics in infant formula with have been found to increase colony counts of bifidobacteria and lactobacilli 13. Colonic fermentation of prebiotics leads to production of short chain fatty acids which is considered as one of the important mechanism through which prebiotics exert their health benefits. Prebiotics are associated with lowering of risk of inflammatory bowel disorders such as Crohn's disease and ulcerative colitis.

Prevention of cardiovascular disease and obesity

Prebiotics play an important role in the management of cardiovascular diseases. Regular consumption of wholegrain is implicated in reduced risk of the vascular occurences 14. Dietary intake of durum wheat has been suggested to increase ferulic acid concentration in blood plasma and is propound to be a puissant factor for the health benefits promulgated for the role of dietary fiber in management of cardiovascular diseases 15. Many animal studies supported by evidences of lowered cholesterol content in total serum is seen in rats fed with prebiotics such as resistant starch, soluble corn bran arabinoxylans and inulin. Experiments in apoE-deficient mice support the fact that dietary inulin (mainly long chain inulin) significantly lowers by about one-third, total cholesterol level16. This is accompanied by a significant decrease in hepatic cholesterol content. Oligo fructosaccharide is protective against the pro-oxidative effects of fructose-rich diet in rats and lower heart lipid oxidation and thus contribute cardioprotective effect of prebiotics 17. In addition, end products of dietary fiber fermentation, that is, short-chain fatty acids (SCFA), can modulate the expression of multiple genes involved in the process of atherosclerosis18. Supplementation of both glucomannan and inulin-type fructans in both normo- and moderately hyperlipidaemic subjects decreases TAG and cholesterol level 19.

The effect of fructan (long chain inulin) supplementation on hepatic lipogenesis and cholesterogenesis in normal subjects in a double-blind, placebo-controlled crossover study was studied and results confirms the experimental data obtained in animals that the hepatic de novo lipogenesis was reduced by feeding fructans at a moderate dose (10 g inu-

Volume : 5 | Issue : 4 | April 2015 | ISSN - 2249-555X

lin per day for 3 weeks)20.However, there is no significant modification of cholesterol synthesis. Supplementation of prebiotics such as short chain FOS induces satiety and thus prevents obesity 21.

Consumption of prebiotic enriched soy food resulted in increase in high-density lipoprotein and reduction in low-density lipoprotein cholesterol and in hyperlipidemic adult 22. Gut peptides is responsible for cascade of events devoted to control food intake, body weight, and glucose metabolism. The "satietogenic" effect of prebiotics results from the excessive production of gut peptides (GLP-1, glucagon-like peptide-1 and PYY) and a decrease in ghrelin peptide 23. The effect of prebiotics on satiety level was studied in ten healthy human subjects where results showed decreased satiety levels after prebiotic supplementation with resultant increase in postprandial plasma gut peptide concentration 24. Prebiotics may prove to be a useful tool for controlling food intake, increase satiety and thus lowering obesity risk.

Anticarcinogenic effect of prebiotics

Prebiotics such as barley when germinated may help in prevention of colitis related colon cancer 25. Prebiotics possess protective effect against colon carcinogenesis due to its fermentation by intestinal microflora producing short chain fatty acids upon and causes alteration of gene-expressions in tumor cells 26. Synbiotic approach in prevention of colon cancer have proved to have a synergistic effect in improving colon carginogenesis.

Prebiotics in Calcium absorption

Extensive experimental studies in animals suggest that prebiotics such as inulin-type fructans can increase the absorption of minerals such as calcium, magnesium, iron, and zinc 27. The role of prebiotics in mineral absorption and thus total bone mineral mass accumulation is important. Significant increase in whole-body bone mineral content (BMC) and whole-body bone mineral density was observed on supplementation of Inulin type fructans in male rats 28. Supplementation of 10 gm/day of a 1:1 mixture of oligofructose (average DP of 4) and long-chain inulin fructans (average DP of 25) in postmenopausal women showed a significant increase of 8.4% in calcium and 9.5% in magnesium absorption. This further emphasizes that the benefit is best achieved with a combination of both short- and long-chain fructans.

Potential sources for prebiotic production

Many industrial food byproducts can be used for synthesis of prebiotics. Soyabean whey is regarded as a functional food ingredient and is a rich source of non digestible oligosaccharide (NDO's) 33. Bengal gram husk and wheat bran are found to be potential source for generation of oligosaccharides when subjected to driselase enzyme hydrolysis 34. Accumulated solid wastes in malting industries such as barley husks and grain fragments when treated using hydrothermal techniques produces liquor containing xylooligosaccharides which on fermentation produce formate, succinate, lactate, propionate acetate, and butyrate exhibiting potential prebiotic properties 35. Studies have also reported on the prebiotic potential of mung bean 36 and apple pomace producing pectic oligosaccharide through simultaneous saccharification and solid-state fermentation 37.

Other new novel sources

Generating prebiotics from new food sources will help explore the varied health promoting properties including prebiotic effects. A study on the effect of diosgenin, a steroid sapogenin compound from yam in murine model showed increase in the growth of enteric lactobacillus implicating the potential role of steroidal sapogenins as a novel prebiotic source 38. Blueberry extracts exhibited prebiotic effect by modifying the bacterial profile by promoting the growth of beneficial bacteria L. rhamnosus and Bifidobacterium breve 39. Lupin kernel fiber is a prebiotic ingredient obtained from legumes and can modulate the human colonic microflora by significantly increasing levels of bifidobacterium spp. and decrease production of clostridia spp.40. Inulin type fructans can be synthesized from the roots Morinda officinalis or Indian mulberry 41.. Dragonfruit is a potential source for the synthesis of oligosaccharides and is shown to stimulate the growth of lactobacilli and bifidobacteria42. . Pleurotus sp.(pleuran) mushrooms is a potential source of prebiotic b-glucans and is used for their immunosuppressive activity and enhancing probiotic activity 43. Glycated pea proteins increases the growth of gut bacteria particularly lactobacilli and bifidobacteria which improves gut modulation and promote health- in humans 44.

CONCLUSION

Prebiotics are a functional compound which helps in improving the quality of life in people ridden with vascular diseases, cancer, obesity and degenerative diseases. Prebiotics has been claimed to prevent weight gain and improve immunity. Understanding of the effects of prebiotics in health and disease could assist in surmounting regulatory issues related to prebiotic use. Numerous potential new applications can be explored for prebiotic use such as drug bioavailability, effects on autoimmune diseases, alleviation of stress and anxiety. Role of prebiotics as antibiotics in animal nutrition is a promising aspect that needs to be explored. The efficacy of prebiotics in alleviating health problems needs to be proved and their underlying mechanism needs to be studied extensively owing to its vast therapeutic potential.

Volume : 5 | Issue : 4 | April 2015 | ISSN - 2249-555X

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