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Review Article

Probiotics and its Health Benefits

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ABSTRACT

Research which concerns the effectiveness of probiotics has shown increasing interest based on the rise of the products, their publications and awareness to the public of their benefits. Probiotics have become increasingly popular over the last two decades for showing a promising desirable result on human health and animal health. Probiotics are defined as the microbial food supplements, which beneficially affect the host by improving its intestinal microbial balance. It has shown to enhance immunity and prevent cholesterol level, cancer, diarrhea, infection, peptic ulcer. In combination with probiotics, symbiotic have also used extensively. Synbiotics is defined as the term where probiotics and robotics are used in combination to give synergistic effect. In this review article various applications of probiotics have also been discussed which have benefitted the human lives.

Keywords: Probiotics, Prebiotics, Synbiotics, microorganisms, Lactobacillus, Enterococcus, Bifidobacterium

INTRODUCTION

Probiotics upon ingestion in sufficient concentration can exert health benefits to the host as they are live microorganisms. This definition of probiotics was derived in 2001 by the united nations food and agriculture organization (FAO) and the World Health Organization(WHO) and has been the term of reference for science and regulation thereafter(FAO/WHO2002). [1]

Lilly and Stillwell first coined the term Probioticsin 1965 in reference to substances produced by protozoa, which stimulates the growth of other organisms. Probiotics consumption as reported exerts various beneficial effects including: enhanced immune response, balancing of colonic microbiota, vaccine adjuvant effects, reduction of fecal enzymes implicated in cancer initiation,

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treatment of diarrhea associated with travel and antibiotic therapy.

Promising probiotics strains include the members of genera Lactobacillus, Bifidobacterium and Enterococcus. The representative species include Lactobacillus acidophilus, L.johnsonii, L.casei, L.*gasseri*, L.*platarum*, L.*rhamnosus*, Bifidobacterium bifidium, B.*breve*, B.*longum*, B.*infantis*, Enterococcus faecelis,E.*faecium* (Furler 1991; Gordin and Gorbach,1992) [2]

Etymologically the term probiotics means "for life" which is derived from Greek language,but its definition has evolved over time simultaneously with the increasing interest in the use of viable bacterial supplements and in relation to the progress made in understanding their mechanism of action.

Desirable properties of probiotic:

The ones currently determined by in-vitro tests are

1- Acid and bile tolerance, which seems to be crucial for oral administration.
2- Adhesion to mucosal and epithelial surfaces, this is an important property for successful modulation, competitive exclusion of pathogens, as well as prevention of pathogen adhesion and colonization.
3- Antimicrobial activity against pathogenic bacteria.
4- Bile salt hydrolase activity.

In order to be effective, the probiotics should have a minimum concentration of 10^6 CFU/ml or gram and that a total sum of 10^8 to 10^9 probiotic microorganisms.

Furthermore, the strains must be able to grow under favorable conditions and should have retained viability under normal storage conditions. Certain studies have demonstrated that viability is not necessary to show all probiotics effects as not all mechanisms nor clinical benefits are directly related to viability and that even cell wall components on some probiotic bacteria or probiotic DNA may have significant health effects.[3].

For maximum activity, the strain should be able to proliferate and colonize at this specific location and should also be tolerated by immune system. It should not be pathogenic, allergic or mutagenic/carcinogenic. For successful applications in foods, the probiotics used should also be technologically compatible with food-manufacturing process. [4]

Characteristics of probiotics will determine their ability to survive the upper digestive tract and to colonize in the intestinal lumen and colon for an undefined period. Some probiotics strains can reduce intestinal transit time, improve the quality of migrating motor complexes, and temporarily increase the rate of mitosis in enterocytes.

Optimum growth temperature for most probiotics is 37°C, but some strains such as L.casein prefer 30°C and the optimum pH for initial growth is 6.5-7.0.[5]

Mechanism of action:

Probiotic bacteria first attach to enterocytes and thus inhibit the binding of enteric pathogens to the intestinal mucosa by the production of inhibitory substances, which includes bacteriocins, lactic acid and toxic oxygen metabolites. The production of hydrogen peroxide is of utmost importance as it exerts a bactericidal effect on most pathogens in combination with the lactoperoxidase-thiocyanate milk system. Attachment of probiotic bacteria to cell surface receptors of enterocytes result in the synthesis of cytokines by signaling events. Furthermore, the production of butyric acid by some probiotic bacteria affects the turnover of enterocytes and it neutralizes the activity of dietary carcinogens, such as nitrosamine, the latter being generated by the metabolic activity of commensal bacteria in subjects consuming a high protein diet.

PROBIOTICS HEALTH BENEFITS

Hypocholesterolemic effects: It works through numerous mechanisms such as

- Assimilation of cholesterol
- Binding of cholesterol to the cellular surface
- Co-precipitation of cholesterol
- Interference with the formation of micelle for intestinal absorption
- Bile acid deconjugation through the secretion of bile salt hydrolase(BSH).

The major role of BSH is deconjugation of bile acid, which makes bile salt less soluble and excreted as free bile acid. This in turn, reduces the cholesterol in serum and increases the Denovo synthesis to replace the lost bile acid. Now cholesterol could be removed in higher amount in the presence of bile as it acts as a surfactant and allows cholesterol to attach onto the bacterial cell membrane.

Dermal health: Recent studies showed that probiotics could improve atopic eczema, wound and scar healing, and help skin rejuvenation. Lactic acid bacteria can produce bioactive peptides known as bacteriocins that have antimicrobial activity against pathogenic bacteria. Based on the studies that have been done, probiotics pose a promising potential benefit, although its effects could be strain- specific, dosage dependent, and application reliance.[1]

Bacterial overgrowth: It is indicated that mild bacterial overgrowth can be treated with Lactobacilli and diarrhea caused due to irradiation of the abdomen has been reported to reduce by the administration of probiotics.

Lactose intolerance: It occurs in approximately 70% of the population worldwide. In adults, the digestive symptoms are less severe abdominal pain, cramps or flatulence. It is indicated that yogurt improves the absorption of lactose in lactase deficient patients and can limit the digestive symptoms.

Anticarcinogenic properties: Goldin and Gorbach reported that the introduction of L.acidophilus into the diet lowers the incidence of chemically induced colon tumors in rats.
The possible mechanism for this is that it inhibits intestinal bacterial enzymes that convert procarcinogens to more proximal carcinogens.

Probiotics in diabetes and obesity: Human and Animal studies have suggested that gut flora enhance body weight gain and increases insulin resistance. The mechanism associated with gut flora-mediated pathology of obesity and diabetes are through

- Increased energy harvest
- Increase blood LPS level (endotoxemia)
- Low-grade inflammation

Therefore, modulation of gut flora has been considered as a potential target to treat against obesity and diabetes. One of the studies by Yadav *et.al* suggested that probiotic Dahi suppressed the diabetes progression and its complications through enhancingthe antioxidant system. Recent studies have shown that probiotic-based selective strains of Lactobacilli and Bifidobacteria show beneficial effects on obesity and type2 diabetes. Although animal studies have shown promising results in probiotic mediated suppression obesity and diabetes, very few studies in humans showed the significant effects. Hence a well-designed studyis required in the treatment, and focus should also be done on its mechanism of action.[11]

Infection control: Probiotics can modify gut pH, antagonize pathogens through the production of antimicrobial compounds, competing for pathogen binding and receptor sites as well as for available nutrients and growth factors, stimulating immunomodulatory cells, and providing lactase. In 1994, WHO deemed probiotics to be the next most important immune defense system when commonly prescribed antibiotics are rendered useless by antibiotic resistance.

Irritable bowel syndrome: This is a very common functional gastrointestinal disorder. Patient experience recurrent abdominal pain or discomfort, bloating, disturbance in defecatory function.[8]
Probiotics have shown to be effective in Crohn's disease and in the treatment of some forms of IBD.[9]

Demise of the needle: Probiotic strains of Lactobacillus used as oral vaccines are very much active against many diseases caused by bacteria, virus, protozoa.

Malaria: Merozoite surface protein 1[MSP1] is a common surface protein that is found in Plasmodium species. This protein plays an essential role as high-level expression of the protein at an asexual stage marks its entry in RBCs. Matured merozoite contains a carboxyl-terminal 19-ku fragment (MSP-119) on its surface.

These protective antigens can be delivered to the mucosal surfaces using live bacteria- containing plasmids responsible for the expression of a specific antigen, which is derived from attenuated pathogenic microorganisms such as S.typhi and chlorella. As an alternative LAB as a live antigen candidate can be used as it can survive with a retention time of 2-3 days in the gastrointestinal tract of animal and human. It does not elicit a strong host immune response because it does not destroy or colonize the mucous membrane. Immunogenicity of soluble protein is low when administered orally, but by using genetically engineered bacteria, immunogenicity can be enhanced, so the low-level expression of MSP-119 in L.lactis is still able to elicit strong protection against malarial parasites.

AIDS: AIDS is a deadly disease. In the past few years, multiple strategies have been discovered to combat this disease. In a study conducted in mice, it was demonstrated that oral administration of recombinant L.lactis encoding the V2-V4 loop of the HIV gene could induce HIV-specific mucosal and systemic immunity. An induced humoral and cell-mediated immune response is sufficient to impart immunity against an HIV EnV-expressing vaccinia virus challenge in mice. Oral administration of recombinant L.lactis associated vaccine that contains the V2-V4 loop of the HIV can protect against AIDS and also significantly reduce viral load. These findings make recombinant L.lactis an appropriate candidate for HIV vaccine development.[11]

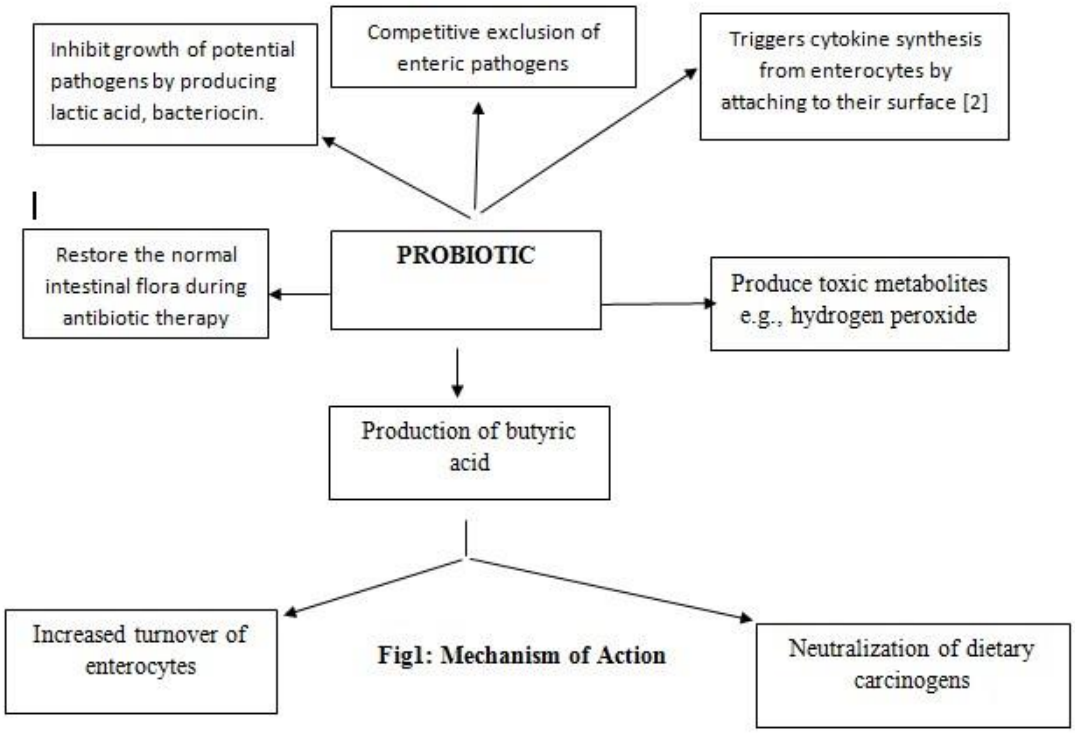

Fig1: Mechanism of Action

Applications

Food application of probiotics

Dairy-based probiotic foods: Milk and its products are a perfect vehicle of probiotic strain and play an important role in delivery of probiotic bacteria to human. They provide a suitable environment for their growth and viability. Factors headed for applying probiotics in dairy products are the viability of probiotics in dairy, physical, chemical and organoleptic properties of final products, probiotic health effect, regulations, and labeling issues. Non-dairy based probiotics products: A suitable media can also be offered by fermented vegetables to deliver probiotics as well as fruit juices which contain beneficial nutrients and are ideal medium for probiotics.

Probiotic for animal nutrition:

Probiotic and their use in animal nutrition and feeding are directly related to their verified efficacy in maintaining the equilibrium of the intestinal microbiota, a.k.a. intestinal homeostasis. The intake of probiotic strains may have an important impact on the absorption and utilization of feed on metabolism, and on several parameters such as daily and total body weight gain of a wide range of farm animals including, poultry (chicken and turkey), cattle, pigs and horses.[10]

FUTURE PROSPECTS

Symbiotic: It is a term which is used when probiotics and prebiotics are used in combination.

A prebiotic is a non-digestible food ingredient that stimulates the growth or activity of one or a limited number of bacteria in the colon, thus improving the host health.The combination of prebiotic and probiotic has synergistic effects because, in addition to promoting the growth of existing strains of beneficial bacteria in the colon, symbiotic also act to improve the survival, implantation, and growth of newly added probiotic strains.[4]

CONCLUSION

There are shreds of evidence that probiotics have shown a wide range of positive result on human as well as on animal health. Various studies have also proven that it has a stimulating effect and people are also consuming it in their diet. Several studies are still going on to prove certain aspects. Studies have also reported that symbiotic have also emerged as a promising health effect in today's era and further clinical studies are needed to demonstrate the safety, efficacy and limitations of a putative probiotic to determine its effect on the immune system in healthy and diseased individuals and effects of a long term consumption, and to resolve whether it is superior to existing therapies.

Figure 2: Health benefits

REFERENCES

1. Lye Huey Shi, Kunasundari Balakrishnan, Kokila Thiagarajah, Nor IsmalizaMohd Ismail and 1Ooi Shao Yin.Beneficial Properties of Probiotics. Tropical Life Sciences Research, 2016; 27(2): 73–90.
2. Kaur IP, Chopra K, Saini A. Probiotics: potential pharmaceutical applications. Eur J Pharm Sci., 2002; 15(1): 1-9.
3. Maria Kechagia, DimitriosBsaoulis, Stavaroula Konstantopoulos, Dimitriadi. Health Benefits of Probiotics: A Review,Hindawi Publishing Corporation,2013, 1-7.
4. Ravindra Nagpal, Ashwani Kumar, Manoj Kumar, Pradip V, Behare, Shalini Jain, & Hariom Yadav. Probiotics, their health benefits and applications for developing healthier foods: a review. FEMS Microbiology letters,2012; 1-15.
5. Danfeng Song, Salam Ibrahim and Saeed Hayek. Recent application of probiotics in food and agricultural science.
6. A Mercenier , S Pavan, B Pot. Probiotics as biotherapeutic agents: present knowledge and future prospects. Curr Pharm Des. 2003; 9(2): 175-191.
7. A.A. Amara, A. Shibl. Role of Probiotics in health improvement, infection control and disease treatment and management. Saudi Pharma J,2015; 23(2): 107-114.
8. Clarke G, Cryan JF, Dinan TG, Quigley EM. Review article: probiotics for the treatment of irritable bowel syndrome--focus on lactic acid bacteria. Aliment Pharmacol Ther. 2012 Feb;35(4):403-13.
9. Sylvia Santosa, BASc, Edward Farnworth, PhD, Peter J.H. Jones, PhD, Probiotics and Their Potential Health Claims, *Nutrition Reviews*, Volume 64, Issue 6, June 2006, Pages 265–274.
10. Zommiti M, Chikindas ML, Ferchichi M. Probiotics-Live Biotherapeutics: A Story of Success, Limitations, and Future Prospects-Not Only for Humans. Probiotics Antimicrob Proteins. 2020 Sep;12(3):1266-1289. doi: 10.1007/s12602-019-09570-5. PMID: 31376026.
11. Vinod Singh, Sarika Amdekar, Hariom Yadav, Nagendra Nath Mishra and Shailinijain. Future Application of Probiotics: A Boon from Dairy Biology. Springer,2011; 87-100.