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Current review on Probiotics health benefits

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Abstract : Humans are a unique reservoir of group of microrganism, and serve as a home to over 100–1000 species of micro-organisms, effecting the internal environment of the humans and thereby, play an important role in maintaining the health. The functional foods have become a part of an everyday diet and are exhibiting potential health benefits beyond the widely accepted nutritional effects. Currently, the most important and frequently used functional food compounds are probiotics. The dairy products has been an important resource for developing nutritious foods which could beneficially affect the host by improving the survival and balance of live microbial dietary supplements in the gastrointestinal flora. In current scenario the microbiota has developed resistance and tolerance to existing conventional drugs and antibiotics that has decreased the efficacy of the drug. Supplementation with probiotics, has shown to be effective against various enteric pathogens due to their ability to compete with the pathogenic microbiota for their adhesion sites, to isolate pathogens or to modulate and regulate the immune response of the host by initiating the activation of specific genes of the host intestinal tract. Henceforth, a simple, low-cost, favourable and essential approach to achieve health benefits is vital in the present time. The purpose of this paper is to focus on the possible beneficial properties of probiotic bacteria like in diarrhoea, anticancer property, development of brain ,allergic reactions , and their possible mode of action.

Keywords : Probiotics, Dairy Products, Adhesion Sites, Intestinal Tract, Health Benefits.

Introduction

More than a century has passed since Tissier has observed that the presence of gut microbiota from healthy breast fed infants were dominated by rods with a bifid shape (bifidobacteria) which were absent from formula fed infants suffering from diarrhoea, establishing the concept that they played a role in maintaining health. Increasing consumer awareness about the health and nutrition has created a supporting environment for the development of the functional food concept that has been introduced to describe foods or food ingredients

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exhibiting beneficial effects on the health of the consumers. The functional food market is expanding, especially in Japan, with further prospective of growth in Europe and the United States and in most countries the largest share of its products is held by probiotics [1, 2]. The term probiotic is derived from the Greek language meaning "for life" but the definition of probiotics has evolved over time. The term was originally used to describe substances produced by one microorganism that stimulated the growth of others and was later used to describe tissue extracts that stimulated microbial growth and animal feed supplements exerting a beneficial effect on animals by contributing to their intestinal flora balance [3]. The most accepted definition contributing to development of probiotics was given by Fuller, Fuller: "probiotics are live microbial feed supplements which beneficially affect the host animal by improving microbial balance"[4]. At present the definition of probiotics was given by the Food and Agriculture Organization of the United Nations World Health Organization, according to which probiotics has been are redefined as "live microorganisms which when administered in adequate amounts confered a health benefit on the host."[5]. The strains classified as lactic acid bacteria are of most significant belonging to the species of *Lactobacilli* (*L. acidophilus, L. casei, L. crispatus, L. gallinarum, L. gasseri , L. johnsonii , L. paracasei, L. plantarum, L. reuteri, L. rhamnosus*) and species of *Bifidobacterium* (*B. adolescentis* ,*B. animalis* , *B. bifidum , B. breve, B. infantis* , *B. lactis, B. longum*) [6].

Essential properties for probiotics to be effective

There are certain essential properties that are exhibited by probiotics as it was determined by *in vitro* tests. These are as follows:

- The probiotic strain survives in the site of its action and tolerated by the immune system.
- It should be non-pathogenic, non-allergic, or non- mutagenic/carcinogenic
- For showing its maximum activity, the probiotic strain should proliferate, colonize and survive at this specific location [7].
- For oral route administration , acid and bile tolerance which seems to be crucial for oral administration,
- It have antimicrobial activity against pathogenic bacteria,
- Adhesiveness to epithelial and mucosal surfaces, for better immune modulation.
- The probiotic strain must be from human origin[8]
- For effective results probiotic products should have a minimum concentration of 10^6 CFU/mL or gram and having 10^8 to 10^9 probiotic microorganisms to be consumed daily [9].

Mechanisms of Action of Probiotics

The possible mechanisms of actions are as follows:-

1. The ability of adhesiveness of probiotics to the mucosal layer of intestine, which is also most important for modulating the immune system [10] and it has antagonist effect against pathogens [11]. This specific adhesiveness properties due to the interaction between surface proteins and mucins thereby inhibiting the growth and multipilaction of pathogenic bacteria and which is due to the result of antagonistic activity by some strains of probiotics against adhesion of gastrointestinal pathogens [12].
2. Its ability to produce antimicrobial substances- probiotics includes the formation of organic acids, and the production of antibacterial substances termed bacteriocins. The organic acids, includes acetic acid and lactic acid, causing inhibition of Gram-negative bacteria, and there by acting as important antimicrobial compounds which is responsible for this inhibitory activity against pathogens by lowering of the intracellular pH or by the accumulation of the ionized organic acid intracellularly that lead to the death of the pathogen. However, bacteriocin-mediate the killing of pathogens through destruction of target cells by formation of pore and/or by inhibiting the cell wall synthesis [13 - 18]
3. The probiotic bacteria shows its immunomodulatory activity by interacting with epithelial and dendritic cells (DCs) and also with monocytes/macrophages and lymphocytes [19].
4. Probiotic bacteria show its competence with invading pathogens for their binding sites on the epithelial cells and the overlying mucus layer [20] .
5. Bacteria interact with each other as well as with their surrounding environment through chemical signalling molecules called auto-inducers. This phenomenon is called quorum sensing [21]. This signaling mechanism facilitates the regulation of important traits of enteric microbes that allow their colonization or infection in their host [22]. Also demonstrated that *Lactobacillus acidophilus* secretes a molecule that

inhibits the quorum sensing signalling or directly interact with bacterial transcription of *E. coli* O157 gene, involved in colonization and thus, bacterial toxicity is opposed. [23]

Molecular characterization of probiotics marker genes and surface layer protein (SlpA)

In view of increased demand of their commercial value, particularly in the developing functional or health food market, the correct identification and processing of probiotic cultures has now become more important to check the possibility of false claims and identify the probiotic preparations [24]. The phylogenetic information encoded by 16S rRNA gene has enabled the development of molecular biology techniques, which allow the characterization of the whole human gut microbiota [25]. Many molecular techniques have been developed for the identification of various probiotic marker genes such as bile salt hydrolase (BSH), mucus-binding protein (mub), fibronectin-binding protein (fbp) for the screening of probiotic strain.

Bile salt hydrolase (BSH) gene

BSH, an intracellular enzyme found more commonly in certain intestinal bacteria, that catalyzes the hydrolysis of glycine- or taurine-conjugated bile acids into the amino acid residue and deconjugated bile acid. This ability of probiotic strains to hydrolyze bile salts have also been used for the selection of probiotic strain, and a number of BSHs have been identified and characterized. It has been investigated that *Lactobacillus* isolates of human origin along with *Bifidobacterium* also possess *bsh* homologs in their genome. Sequence analysis of these *bsh* homologs establishes intraspecies heterogeneity and interspecies homogeneity, which might be due to the horizontal transfer of *bsh* gene from one species to other. The probiotic genomeses of *Lactobacilli* and *Bifidobacteri* strains reveal that many possess more than one *bsh* homolog and each BSH may respond to different types of bile or perhaps different length of exposure to bile [26].

Mucus-binding protein (Mub), Fibronectin-binding protein (FbpA), and surface layer protein (SlpA)

The *mub* gene encoding mucus-binding protein in *Lactobacillus reuteri* ATCC 53608 (strain 1023) was identified. The immunoglobulin G (IgG) fraction of an antiserum was used against cell surface proteins of *L. reuteri* ATCC 53608 (strain 1023), then screened a phage library that identified a number of clones that were found to be reactive with the antiserum and adhered to mucus. Subcloning resulted in the identification of the *mub* gene, and domains with the two main types of repeats, such as Mub1 and Mub2, were shown to be more adherant to mucus after recombinant expression in *Escherchia coli* [27]. The genes encoding for FbpA, Mub, and SlpA were found to contribute to their ability of *L. acidophilus* NCFMto adherant to Caco-2 cells *in vitro*, thereby confirming that adhesion is determined by multiple factors [28].

The Health Effects of Probiotics for Human

a. **Acute diarrhea**- Probiotics are being used for the treatment of acute diarrhea as confirmed in the following studies of the health benefits of probiotics.In the study performed in 26 children in Thailand having watery diarrhea showed a reduction in shortening the duration of symptoms for those who had received treatment with *Lactobacillus* GG [29]. In another Clinical trial study performed in 130 children, the use of *Saccharomyces boulardii* showed its effectiveness for the treatment of acute diarrhea in these children [30], and, a similar results were reported in another study involving 92 adults [31].
b. **Traveler's diarrhea**-Probiotics were found to effective in treatment of traveler's diarrhea performed in 12 randomized controlled trials showed that probiotics found to be safe and effective using *Saccharomyces boulardii* and also a mixture of *Lactobacillus acidophilus* and *Bifidobacterium bifidum* was found to be efficacious[32]
c. **Allergic disorders** – It was found that *Lactobacillus GG* when used in combination with B. lactis during pregnancy and breastfeeding reduced the risk of atopic eczema and allergic sensitization in child [33].
d. **Immune response**-Probiotics have been shown to stimulate the innate immunity and modulated the pathogen induced inflammation via toll-like receptor-regulated signaling pathways [34].
e. **Anti-cancer-** Using the probiotic strains of, *Lactobacillus fermentum* NCIMB-5221 and -8829, in *in vitro* studies have shown to be highly effective by suppressing the colorectal cancer cells and also promoting the growth of normal epithelial colon cell through the production of SCFAs (ferulic acid).This anticancer activity was further compared with other probiotics such as *L. acidophilus* ATCC 314 and *L. rhamnosus* ATCC 51303 which were previously having this tumorigenic activity [35].

f. Effect on **nervous system-**The effect of probiotics was studied on the CNS in clinical trials, where it found that the gut microbiota influenced the human brain development and its function [36]. It was also observed that probiotics reduced the psychological distress in a randomized trial study that involved healthy volunteers who were treated with oral administration of *Lactobacillus helveticus* R0052 and *B. longum* R0175[37].

Conclusion

Probiotics have potential or promising role in treatment and prevention in various disorders, the evidence in this review indicates that effects of probiotics are strain specific , their efficacy may not be shown by other strains. The probiotics acts by different mechanisms, indications of probiotics usage may be different in various disorders. Several mechanisms throug which the probiotics shows their effects are: adherence to the mucosa and epithelium, modulation of gut microbiota and immune system. From current research undergoing on probiotics promising health benefits are being observed but more clinical studied are required to explore the therapeutics areas of probiotics that could heal the people suffering from various ailments. Also needs more studies to determine the some new strains of probiotics and their effects on long term usage of probiotics that could explore new methods for the treatment or prevention of various disorders and for the health improvement of mankind.

Competing Interests

Authors have declared that no competing interests exist.

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