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A review on probiotic dairy products and digestive health

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Abstract
Probiotics are live bacteria and yeasts that are good for human health, specially for digestive system. Human body is full of bacteria, both good and bad. Probiotics are often called "good" or "helpful" bacteria because they help keep our gut healthy. The health promoting benefits and efficacy of probiotics has been demonstrated in many models of gastrointestinal disease. Probiotics have an antimicrobial effect through modifying micro flora, secreting antibacterial substances, competing with pathogens and bad microorganism to prevent their adhesion, competing with nutrients necessary for pathogen survival, producing an antitoxin effect and reversing some of the consequences of infection on the gut epithelium. Fermented milks, kulfi, cheese, enriched yoghurt, yoghurt-like products are the commonly used Probiotic food preparation.

Keywords: Probiotic, dairy product and digestive health

Introduction
Probiotics are non-pathogenic, harmless flora/living microorganisms (such as lactic acid bacteria and yeasts used in fermentation procedures)**,** which are good for human health. There are good microorganism and bad microorganism found all over the food world. These good microorganisms are called probiotic.
According to the report by FAO/WHO, probiotics are: “Live microorganisms which, when administered in adequate amounts, confer a health benefit to the host”. The most common types of probiotics are Lactic acid bacteria and include specie from the *Lactobacillus*, *Pediococcus* and *Bifidobacterium* genera. Various species including *Lactobacillus rhamnosus* and *Bifidobacterium* have mainly been used as probiotics over the years. An important characteristic of probiotic bacteria is that they need to survive through the gastro intestinal track of the host. As *S. thermophilus* and *L. bulgaricus* are not expected to survive and grow in the host’s intestinal tract, they are not categorized as probiotics by most scientists.

Characteristics of a good probiotics
In different research studies it has been found that probiotics have unique potential properties. These considered for use and selection of probiotic and its safety, technological, and functional characteristics must be sought. Moreover, the following criteria need to be fulfilled:

- Probiotics should be able to create a beneficial effect on host animal by increasing resistance to diseases.
- Probiotics must be from human origin.
- Probiotics needed to have excessive cell viability.
- Probiotics should be non-pathogenic and non-toxic.
- It should be able enough to interact or send signals to immune modulator activity.
- It must have ability to influence local metabolic activity.
- It ought to be fit for surviving and processing in the gut condition like resistance to low pH and organic acids.
- Probiotics must be stable, safe, effective and equipped for staying viable for periods under storage and field conditions.
- It must have power of restore and replace the intestinal micro flora.
- It should have anti-carcinogenic and anti-mutagenic activity, cholesterol lowering effects, can maintain mucosal integrity and can enhance bowel motility.
- It should be able to speed up, facilitate and colonize/maintain the digestive tract.
- They must have the ability to resist gastric juices and the exposure to bile acid which seems to be crucial for oral administration.
- Adhesion to mucosal and epithelial surfaces, an important property for successful immune modulation, competitive exclusion of pathogens, as well as prevention of pathogen adhesion and colonization.

- Antimicrobial activity against pathogenic bacteria.
- Bile salt hydrolase activity.
- Antibiotic resistance may help them to survive in the presence of administered drugs and other antimicrobial compounds.
- Fast multiplication, with either permanent or temporary colonization of the gastrointestinal tract.
- Stabilization of the intestinal micro flora and non-pathogenicity.
- Survival on passing through gastrointestinal tract at low pH and in contact with bile.

Types of probiotics

Although several species and strains of microorganisms are known as probiotics but most probiotic bacteria which are used in the foods are lactic acid bacteria (LAB) that mainly belong to *Lactobacillus spp.* and *Bifidobacterium spp.* Other probiotics include other lactic acid bacteria such as *Enterococcus faecalis*, *Enterococcus faecium*, *Lactococcus* and *Sporolactobacillus inulinus*, and also non-lactic acid bacteria including *Bacillus cereus*, *Saccharomyces cerevisiae* and *boulardii*, *Escherichia coli* and *Propionibacterium freudenreichii* (Homayouni, 2014). Probiotic bacteria which were isolated from Iranian dairy products are described in table 1.

Lactobacillus and *Bifidobacterium* genera are among General Recognized as Safe (GRAS) (foods, as they have a history of safe usage and are non-pathogenic. Both are part of human intestinal normal flora, *Lactobacillus spp.* is isolated from small intestine and *Bifidobacterium spp.* from large intestine (Homayouni, 2014).

Table 1: Probiotic microorganisms isolated from dairy products.

Type of product	Types of probiotics microorganism	Researchs and date of publishing
Buffalo milk	*Lactobacillus paracasei* *Lactobacillus pentosus* *Lactobacillus brevis* *Pediococcus acidilactici*	Iranmanesh, 2013
Azerbaijan traditional cheese	*Lactobacillus casei* *Lactobacillus brevis* *Lactococcuslactis* *Leuconostocdextranicum*	Bonyady, 2011
Azerbaijan traditional cheese	*Lactobacillus fermentum* *Lactobacillus plantarum*	Mirzaee, 2013
Pasteurized yogurt	*Lactobacillus bulgaricus* *Streptococcus thermophiles*	Bonyady, 2011
Rafsanjan traditional yogurt	*Lactobacillus brevis* *Lactobacillus casei* *Lactobacillus plantarum* *Lactobacillus acidophilus* *Lactobacillus rhamnosus*	Farah bakhsh, 2012

Composition of Probiotics

Probiotics can be bacteria or yeast. But most Probiotics are bacteria. Microorganisms that are used as potential probiotic agents are listed in table 2.

Table 2: Composition of Probiotics

Lactobacillus	Bifidobacteria	Other bacteria	Yeast
L. acidophilus spp.	*Bifidobacterium bifidum*	*Enterococcus faecium*	*Saccharomyces boulardii*
L. acidophilus La-1	*B. breve*	*Escherichia coli*	
L. casei spp.	*B. infantis*	*Streptococcus*	
L. rhamnosus GG	*B. longum*	*Salivarius subsp.*	
L. reuteri		*Thermophilus*	
L. plantarum spp.			
L. fermentum KLD			
L. johnsonii			

Functional Dairy Foods

Probiotic Cheese

Cheese is one of the most successful probiotic dairy products that has high potential to carry bacteria. The number of probiotic bacteria in cheese can be more than 10 million and this microbial mass in cheese have more protective effects on probiotic bacteria in comparison to yogurt because of its chemical and physical properties such as low pH, high buffering capacity, high nutrients and high fat levels. Therefore, cheese has been one of the main sources of probiotic microorganisms. Effects of the probiotic *Lactobacillus casei* and *oregano* on *Staphylococcus aureus* in white cheese have been investigated, according to the results, the best concentration of essential oils for inhibition of *Staphylococcus aureus* growth and production of desirable flavor properties was acquired when probiotic bacteria were added (Mahmoudi *et al*, 2010) [7]. In another study the survival of *Lactobacillus plantarum*, *Lactobacillus bulgaricus*, *Bifidobacterium animalis* and *angulatum* at different stages of white cheese ripening was investigated. It was observed that the bacterial population at the end of cheese ripening period was not less than 10^8 (cfu/ml) which is more than the required amount to produce health promoting effects (Ehsani *et al*, 2011) [8].

Probiotic Yoghurt

Yoghurt is a fermentative dairy product which is made of milk and is produced by lactic acid bacteria. In production of

yoghurt two starters are used including *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. But none of the above can survive the digestive tract, thus aren't able to provide probiotic properties since they're destroyed under acidic conditions. Acid-resistant species must be used. Yoghurt is produced by adding probiotic *Lactobacillus* and *Bifidobacterium* in the presence or the absence of starter. Many types of yoghurt with different probiotics have been produced around the world. Many studies have been done on the viability of probiotics during fermentation and storage. Same authors examined the storage temperature for cooling as the third parameter, the best time for the viability of both bacteria is to evaluate the initial probiotic bacteria and the average time for yoghurt preservation (Mortazavian, 2007) [9]. Probiotic yogurt in addition to their nutritional value, have an important role in fighting against the pathogens. Farahbakhsh has performed a research in this area in which antimicrobial effect of isolated probiotic from Rafsanjan local yoghurt on pathogens was investigated and due to this research *Lactobacillus plantarum* had the strongest antimicrobial effect (Farahbakhsh *et al*, 2012) [11].

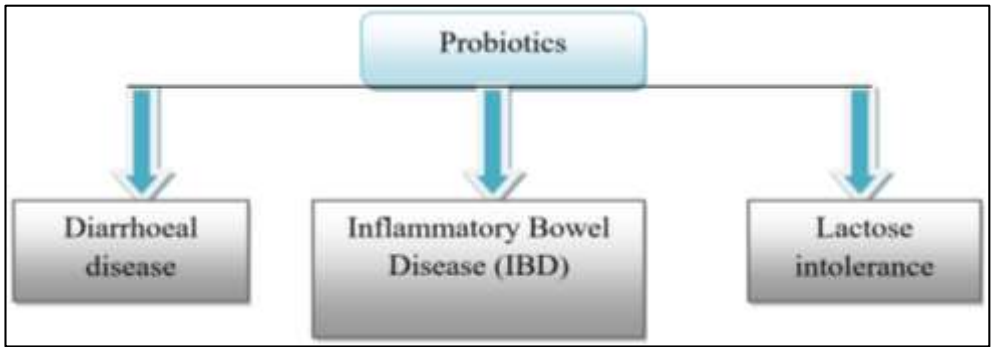
In a similar research, antagonistic effect of lactic acid bacteria isolated from Golestan province yoghurt against 7 important species of digestive pathogens especially *Shigella dyssentriae*, *Yersinia entrocolitica*, *Escherichia coli* and *Salmonella typhimorium* was studied which resulted in the fact that the highest inhibitory effect was about *Lactobacillus casei* and *Lactococcus lactis* and this inhibitory effect was more visible on *Yersinia entrocolitica* (Kianiand, 2006) [13]. Mahmudi investigated the survival of probiotics and other properties of probiotic yoghurt in the presence of different concentrations of mint extract with the count of 10^8-10^9 (cfu/ml) *Lactobacillus casei* as the probiotic agent and they showed that the amount of probiotic bacteria in combination with mint extract in probiotic yoghurt is higher than the minimal amount which is needed for observing the functional effects (Mahmoudi *et al*, 2014). Studies on different factors affecting the durability of probiotics resulted in the fact that this product can be presented as a functional probiotic product.

Ice Cream

Ice cream is one of the safe, nutritional and frozen dairy products which is widely consumed around the world and since it causes a great deal of happiness, it has many fans. Considering its nutritional values, ice cream is a great source of essential amino acids of milk proteins, vitamins and minerals, and its components are easily digested and absorbed in the body (Abghari *et al*, 2008) [14]. Probiotic microorganisms are added to the ice cream mixture in producing fermentative ice cream. Probiotic ice cream has the ability to survive in the human digestive system due to its neutral pH The only problem is the ice cream aeration during the freezing process, which can affect the probiotics survival due to the existence of oxygen. Encapsulation method (micro-covering) in ice cream can solve this problem (Homayouni *et al*, 2008) [12]. In a research performed by Abqari, after adding *Lactobacillus acidophilus*, the survival rate of this bacteria in a type of fermentative ice cream was evaluated and it was observed that required amount (10^8 (cfu/ml)) of bacterial mass survived which is compatible with Probiotics product's definition and can be considered as functional fermentative ice cream (Abghari *et al*, 2008) [14].

Probiotics and gastrointestinal infections

Gastrointestinal infections lead morbidity and mortality worldwide, particularly in developing countries.



Diarrhoeal Disease

Each year gastrointestinal infections are responsible for significant morbidity and mortality worldwide. The World Health Organization (WHO) estimates it to be more than four billion episodes of diarrheal disease annually, while there were 2.2 million deaths attributable to diarrheal disease in 2004, making it the fifth leading cause of death at all ages worldwide. Probiotics have been used in the treatment and prevention of many forms of diarrheal disease.

Inflammatory Bowel Disease

Inflammatory bowel disease (IBD) is a term applied to a group of bowel disorders in which inflammation is a major feature, but where there is no proven evidence that infection is the causative agent. Rare forms of inflammatory bowel disease exist but the two main entities are ulcerative colitis and Crohn's disease. Both share some clinical, pathological and epidemiologic features and are diverse in others. The pathogenesis of IBD is not fully understood, the etiology of both diseases is multi factorial, more and more evidence shows gut micro flora plays an important part in initiating and maintaining the mucosal inflammatory response in IBD. Incorporation of probiotic bacteria has an ability to become stable the immunological barrier in the gut mucosa by declining the generation of local pro-inflammatory cytokines. Probiotics is used for treatment of the inflammatory bowel disease, such as ulcerative colitis, Crohn's disease and Pouchitis. Potential mechanisms include suppression of growth or epithelial binding and invasion by pathogenic bacteria, production of antimicrobial substances, improved epithelial barrier function, and immunoregulation. The effects of probiotic are probably both strain-dependent and dose dependent

Lactose Intolerance

Lactose intolerance is a physiological state in human beings where they lack the ability to produce an enzyme named lactase or β-galactosidases. This lactase is essential to

assimilate the disaccharide in milk and needs to be split into glucose and galactose. Individuals lacking lactase are not being able to digest milk and it often poses a problem in newborn infants. People with lactose intolerance problem express abdominal discomfort, diarrhea, cramps, flatulence, nausea, vomiting, etc. A person suffering from lactose intolerance is advised to take non-milk diet. Lactose intolerance is of 3 types. In primary or adult-type lactose mal-absorption, lactase activity is high at birth, decreases in childhood and adolescence and remains low in adulthood. Secondary forms of lactose mal-absorption may be due to inflammation or functional loss of the small intestinal mucosa and by protein-energy malnutrition. Although some forms are transient, disappearing after recovery from the original disease, others are irreversible. Congenital lactose mal-absorption, a rare autosomal-recessive heritable genetic defect, is evident immediately after birth. Afflicted newborns respond to their first milk feed with diarrhoea.

Mechanism of action

Probiotics have various mechanisms of actions currently, three major ways of action of probiotics have been revealed. The first one is a competition for nutrients and for ecological niche at this time the indigenous anaerobic flora limits the concentration of potentially pathogenic flora in the digestive tract. Probiotics can have a direct effect on other microorganisms through inhibition of pathogen adhesion. This kind of major defense mechanism is used to maintain internal health condition. *Lactobacilli* and *bifidobacteria* have been shown to inhibit a broad range of pathogens by performing colonization of pathogenic bacteria and finally by doing antagonistic activity against gastrointestinal pathogens. This principle in many cases is crucial for the prevention and treatment of infections and restoration of the microbial equilibrium in the gut. The second mechanism is involved in the production of anti-microorganism substances, bacteriocins, toxins, organic acids, short chain fatty acid production, lowering of gut pH. These substances are responsible for inhibit the growth of other harmful microbes such as foodborne pathogens and spoilage organisms in GIT environment then lead to the death of the pathogen by creating antagonistic condition, and such action may result in the inactivation of toxins.

Probiotic mode of effects are carried out based on microbial products which is determine a specific probiotic action and its effective application for the prevention or treatment of a certain disease by destruction of target cell. The third mechanism is the stimulation/modulation of specific and nonspecific immune response by T-cell activation, to cytokine production/throughout immunomodulation by inducing phagocytosis and IgA secretion, modifying T-cell responses, enhancing Th1 responses, and attenuating Th2 responses. This mode of action is most likely important in the prevention and therapy of infectious diseases. Probiotic bacteria can exert an immunomodulatory effect. These bacteria have the ability to interact with epithelial and dendritic cells (DCs) and with monocytes/macrophages and lymphocytes. In various strategies they are interact and modulate the immune system in a good manner. The immunological advantages of probiotics can be because of activation of local macrophages and modulation of IgA production locally and systemically, to changes in pro/anti-inflammatory cytokine profiles, or to the modulation of response towards food antigens.

The probiotics have a three step action mechanism

- It stimulates and modulates immune response.
- It normalize intestinal micro flora by ensures colonization resistance and controls irritable bowel syndrome and other inflammatory bowel diseases.
- The final mechanism is also have the metabolic effects like-bile salt deconjugation and secretion, lactose hydrolysis, reduction in toxigenic and mutagenic reactions in gut, Supply of nutrients to colon epithelium.

Conclusion

The consumption of probiotics helps to lead a healthy life. Currently, this is globally a well-accepted concept and guarantee for the next generation. Probiotic also helpful for patient who suffers from the lactose intolerance problems. Probiotics are widely used in order to solve and simplify particular diseases. In future highly emphasized further *in vitro* and *in vivo* experiments should be designed and conducted to identify true probiotics and to select the most suitable ones for the prevention/ treatment of diseases. Lastly, recommend action for further practical studies need confirmation about its effect in human health with high quality research and well-designed clinical trials.

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