

Review Synbiotics “ Combination of Probiotics And Prebiotics ”

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Abstract: The principal role of food in a body is to supply required nutrients which provides energy to sustain for physiological functions and well being. All food types are functional, consumption of such functional food provides bioactive molecules. Probiotics, prebiotics and synbiotics are important bioactive components of functional food which have significant role on well being of human and animal. These bioactive components provides one of the possible approach for improving the health image and developing functional products. Discovery of new prebiotic/probiotic/synbiotic functional foods leads to the food industry to renew constantly by introduction of food items with enhanced nutritional value and also with health advantage for consumers. This review provides information regarding health benefits of synbiotic food compounds as they provide bioactive components for health.

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I. Introduction

Food development for health and well being is one of the key research priorities of the food industry (Klaenhammer and Kullen 1999). Health benefits of certain foods have been investigated from many years. This trend leads to increase in production and consumption of food enriched with bio active components such as prebiotics, probiotics and synbiotics which are recognized in form of functional foods (Shanahan 2004). The term functional food was introduced by Japan in 1980's. This type of food is called as food for specified health. In everyday life, functional food is important part of diet, it have so many health benefits and it reduces the risk of chronic diseases.

Gibson & Williams, (2005) reported specific characteristics of functional food

- It may be consumed as part of the normal diet,
- It is composed of naturally occurring components in unnatural composition,
- Generally present in foods that would not normally supply them,
- Have a positive effect on target function,

It may have nutritive value, enhances basic nutrition,

- It will increase well-being and health,
- It reduces the risk of disease,
- It provide health benefits, it improve the quality of life including physical, psychological and behavioral performances.

Functional food comprises conventional foods containing naturally occurring bioactive substances (e.g. dietary fiber), foods enriched with bioactive substances (e.g. probiotics, antioxidants) and synthesized food ingredients introduced to traditional foods (e.g. prebiotics).

Probiotics

Probiotics are supplements made up of live microorganisms which, when administered in adequate quantities provide health benefits to humans and animals (Gregor, 2006). In other words we can say probiotics are live microorganisms which benefit the host by increasing its microbial balance. Idea of consuming live microorganisms for health was proposed by Eli Metchnikoff (Francesca *et al.*, 2010). The term probiotic was introduced while comparing the detrimental effects of antibiotics and other antimicrobial substances on the gut microbial population (Jankovic *et al.*, 2010). Probiotics are used as food supplements, due to mounting scientific evidences supporting the concept that the maintenance of healthy gut microflora may provide protection against

gastrointestinal disorder including infections and inflammatory syndromes of the bowel (Shanahan 2002 , Madden and Hunter 2002, Shanahan 2004, Nomato 2005 , Parvez *et al.* , 2006).

Compounds produce by various probiotic bacteria have inhibitory action on growth of pathogens, it include organic acids (lactic and acetic acids), bacteriocins, and reuterin. The organic acids not lower the pH, and affects the growth of the pathogen, but they can also be toxic to the microbes (Tambekar and Bhutada, 2010). There are so many evidences which show that probiotics are beneficial in gastrointestinal disturbances, such as diarrhea, dysentery, typhoid etc (Tambekar and Bhutada, 2010). It is important to mention it when considering the effectiveness and biological activity of probiotics, that they are food products and not drug.

Tuomola *et al.*, 2001 reported criteria for initial screening and selection of probiotics

- Phenotype and genotype stability,
- Plasmid stability,
- Carbohydrate and protein utilization patterns,
- Acid and bile tolerance and survival and growth,
- Intestinal epithelial adhesion properties,
- Production of antimicrobial substances,
- Antibiotic resistance patterns,
- Ability to inhibit known pathogens, spoilage organisms, or both and immunogenicity. Probiotics has to be harmless to the host, there must be no local or general pathogenic, allergic or mutagenic/ carcinogenic reaction provoked by the microorganism itself, in its fermentation products or its cell component after increase of the bacteria.

Characteristics features of probiotics

Inuet *et al.* , 2001 ; Harish *et al.* , 2006 reported following characteristics of probiotics

- It should have a demonstrable beneficial effect on the host,
- It should be non pathogenic in nature,
- It should be non toxic,
- It shouldn't have any adverse effects on humans and animals,
- It should be able to survive in the gastro intestinal tract environment,
- It should retain the stability during the intended shelf life of the product,
- It should contain adequate number of viable cells to confer the health benefit,
- It should be compatible with product storage containers to retain the stability.

Ouwahand *et al.*, 1999; Zubillaga *et al.*, 2001; Holzappel & Schilling 2002 reported some important physiological effects which are related to probiotic bacteria includes

- The reduction of pH of gut
- Production of important digestive enzymes and vitamins
- Production of important antibacterial substances, e.g., organic acids, bacteriocins
- hydrogen peroxide, diacetyl, acetaldehyde, lactoperoxidase system, lactones etc.
- Reconstruction of normal intestinal microflora , a disorders caused by diarrheas, antibiotic therapy and radiotherapy
- Reduction of level of cholesterol in the blood,
- Initiations of immune functions,
- Suppression of bacterial infections,
- Removal of carcinogens,
- Improvement of calcium absorption as well as the reduction of faecal enzyme activity

To achieve a status of probiotic microorganisms must fulfill following criteria related to safety, functional effects and technological properties (FAO/WHO, 2001).

From the viewpoint of safety,

- The probiotic microorganisms should not be pathogenic,
- Have no connection with diarrhoeagenic bacteria and
- Do not possess ability to transfer antibiotic resistance genes, as well as be able to maintain genetic stability,
- Effects of these have been evaluated in preclinical trials, and they have promising results for inflammatory diseases and obesity.

List of few important species of microbes used as probiotics

(Koji *et al.* , 2005 ; Julienet *al.* , 2010)

1. **Genus** : *Lactobacillus***Species** : *acidophilus* , *brevis* , *delbrueckii* , *fermentum* , *gasseri* , *johnsonii* , *paracasei* , *planatarum* , *reuteri* , *rhamnosus* , *salivarius*
2. **Genus** : *Bifidobacterium***Species** : *adolescentis* , *animalis* , *bifidium* , *breve* , *infantis* , *longum*
3. **Genus** : *Streptococcus***Species** : *thermophilus* , *salivarius*
4. **Genus** : *Saccharomyces***Species** : *cerevisiae* , *boulardii*
5. **Genus** : *Escherichia***Species** : *coli*
6. **Genus** : *Bacillus* **Species** : *coagulans* , *clausii*
7. **Genus** : *Enterococcus***Species** : *faecium*

Viability of Probiotics

Shelf life of probiotic bacteria is important aspect to assess viability of functional food. Along with their viability, the quantity is also one of great important point because many probiotic bacteria are eliminated during food preservation and by passing through the gastrointestinal tract. There are so many factors which affects the viability such as the type of the dairy product, existing air and low preservation temperature. Dairy products have their pH buffering capacity which can help the survival of probiotic bacteria. Most probiotics are anaerobic, they are resistant to the acidic environment of the stomach and the food itself (such as yoghurt). There are some methods to increase probiotics viability like protection of probiotics using micro-covering or microencapsulation methods. Micro-covering is a technology in which we can pack small particles of solid, liquid or gas inside small mobile beads which can release their contents under specific conditions after a specific period of time. For probiotic capsulation we use alginate and its derivatives, modified starch, mixture of xanthan and gelatine, carrageenan and its derivatives, gelatin, chitosan and cellulose acetate. In Iran different methods of micro-covering have been observed used for probiotic viability. Homayouni, 2008 observed that the probiotic bacterial viability in ice cream containing modified starch has increased after 180 days of preservation in -20° C. In white Iranian cheese, high fat content, dry matter and pH are important in increasing viability, it holds the functional effect by encapsulation of *Lactobacillus acidophilus* with calcium alginate and resistant starch. Another method to increase probiotic viability is bi-phasic fermentation of yoghurt and fermentation of neutralized milk, in which the amount of *Lactobacillus acidophilus* and *Bifidobacterium langum* increased in the product. Another solution is to use genetic manipulations to produce the new varieties of probiotics. Primary microbe must be among normal microflora of human digestive system (Homayouni, 2008).

Probiotic bacteria possess the capacity to resist the digestion process in the stomach, and the intestinal track. After these bacteria passes through the stomach, they initially enter the upper intestinal track, in this area bile is secreted into the gut. Bile concentration varies in the human gastrointestinal system, and it is difficult to predict bile concentration at any given movement Lankaputhra and Shah (1995). After moving through this harsh environment, the organisms colonize into the epithelium of the lower intestinal track, where they are able to tolerate acid and bile acids, attach to epithelium, this provides health benefits.

Prebiotics

Prebiotics are undigestible food substances which gives a beneficial physiological effects on host by initiating suitable growth or activity of limited number of indigenous bacteria. Prebiotics plays important role in fermentation of carbohydrates, which are not digested easily or slowly digested in the small intestine , and stimulate, *Bifidobacteria* growth and growth of some gram-positive bacteria, which belongs to the probiotic bacteria , administered by humans. Complex carbohydrates passes to the small intestine, than to the area of lower gut where they become available for colonic bacteria but are not utilized by the majority of the bacteria present in the colon. There are some important examples of prebiotics which are used in human nutrition - lactulose, galactooligosaccharides, fructooligosaccharides, inulin and its hydrolysates, maltooligosaccharides, and resistant starch. Short-chained fatty acids like acetate, butyrate and propionate, are main end products of carbohydrates which are used by host organisms as a source of energy.

De Vrese & Schrezenmeir, 2008 reported that carbohydrates as oligofructose, inulin, fructooligosaccharides (FOS), galacto-oligosaccharides (GOS), soybean-oligosaccharides, transgalactooligosaccharides, gluco-oligosaccharides, gentio-oligosaccharides, xylo-oligosaccharides, lactulose, isomalto-

oligosaccharides, and polysaccharides as pectins and starch are considered as efficient prebiotic substances. Macfarlane *et al.*, 2006; Brown *et al.*, 2015; Rezaei *et al.*, 2015 studied on prebiotics and investigated that the inulin-type fructans (inulin, FOS) and GOS selectively stimulate the *Bifidobacteria* growth. Gulewicz *et al.*, 2003 mentioned three different ways to produce prebiotic oligosaccharides : by extraction from plant materials, microbiological synthesis or enzymatic synthesis, and enzymatic hydrolysis of polysaccharides.

SYNBIOTICS

The synbiotics are important functional food compounds. Scientists are keenly interested in synbiotic theory as it leads to the combination of probiotics and prebiotics. Synbiotic targets towards two different areas of the gut, both the small and large intestinal tracts. Probiotic bacteria are stimulated by prebiotic oligosaccharides in the colon. Deng *et al.*, 2015 reported that probiotic microorganisms use prebiotic carbohydrates for its growth and replication in gut. Prebiotics increases chances of the survival of probiotic organisms, due to its special substrate specificity, substrates are promptly available for fermentations.

It has been reported by Rafter *et al.*, 2007 that consumption of synbiotics reduces risk factor of cancer in patients suffering from colon cancer. Liong, 2008 have done studies on animal and reported that combining both probiotic and prebiotic have defensive effect on the development of colon tumor, invention of synbiotics resulted in modification of fecal flora. *Lactobacillus* and *Bifidobacterium* were increased and *Clostridium perfringens* reduced. In addition, it is imperative to select a mixture of a definite substrate and a microorganism for a synbiotic product that can enhance the advantageous effect when compared to a product including a probiotic or a prebiotic only (Capela *et al.*, 2006; Huebner *et al.*, 2007).

Some people do not consume milk products out of principle or due to lactose intolerance. Therefore, probiotic containing products from plant origin could be a valuable alternative. For this fermentation is a good process, fermentation makes certain vegetable and milk, products more suitable for consumption, e.g through removal of anti nutritional factors. Most of vegetables often common digestible or slowly digestible oligosaccharides although these carbohydrates can be metabolized by the microbiota in the caecum and colon (Hogberg, 2004) but they also require support from some additional bacteria from foods. (Okada, 2006).

The most common fermented vegetables are sauerkraut and soured gherkins which are fermented mainly by lactic acid bacteria that are important in flavor formation (De palancia, 2006 ;Berdague, 1993). In Mediterranean countries, olives and Brussels sprouts are known fermented food (Jung *et al* and Lin *et al.*, 2006). Fermentation used to be a spontaneous process, but it require some starter (Gardner *et al.*, 2001). Vegetables juice have been fermented and earlier research reported that they may function as a vehicle for probiotic delivery (Karovicova *et al.*, 1999). It has been reported that carrot juice was chosen as a model for vegetable fermentation and as a new potential carrier for probiotics because of its sweeter taste. Fermentation of carrot juice decrease the level of sugars and acidification provides a fresh taste. Suitability of carrot juice as raw material for the production of probiotic food with *Bifidobacterium* strains was investigated (Kun *et al.*, 2006). Yoon and others also tested the suitability of cabbage to produce probiotic cabbage juice and suggested that fermented cabbage juice support the viability of probiotics and serve as healthy beverage (Yoon *et al.*, 2006). Moreover, soybean has received lot of attention from the researchers due to its high protein content, Soymilk is suitable for growth of *Lactic acid bacteria* and *Bifidobacteria* (Chou *et al.*, 2000 ; Wang *et al.*, 2002). Pomegranate juice was proved to be a suitable probiotic drink as results have shown desirable microbial growth and viability for *Lactobasillus planatarum* and *Lactobasillus delbruekii*.

II. Conclusion

Gut microbiota plays an important role in human health, and the variation in the gut microbiota may be used to treat and prevent an array of diseases. Prebiotics, probiotics, and synbiotics are important and have preventive and therapeutic measurements for human medical disorders. Their efficacy depends on the types and nature of the disease and the probiotic strain. In future, research on probiotics will focus on human trials as well as mechanisms of action of probiotics, to provide more data on different probiotics strains and mixtures. New advances will be going in research by using metagenomics and bioinformatic tools, the field of prebiotics, probiotics, and synbiotics will continue to grow as these agents are being evaluated in the modulation of intestinal health.

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