



## PROBIOTIC DAIRY PRODUCTS: PRODUCTION AND SENSORY EVALUATION

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Received: 14<sup>th</sup> July 2015, Accepted: 24<sup>th</sup> Aug 2015.

### ABSTRACT

Foods that affect specific functions or systems in the human body, providing health benefits beyond energy and nutrients, functional foods have experienced rapid market growth in recent years. This growth is stimulated by technological innovations and development of new products. The increasing Number of health-conscious consumers are interested in products that improve life quality. Since the global market of functional foods is increasing annually. Probiotics show considerable promise for the expansion of the dairy industry, especially in such specific sectors as yoghurts (Indian dahi), cheeses, beverages, ice creams, and other desserts. This article presents an overview of functional food and strategies for their development with some attention to probiotic dairy products. The special attention is paid to the sensory of such products to provide important information about the most desirable attributes.

**KEYWORDS:** Functional foods, Dairy Products, Sensory properties, Probiotic strains.

### INTRODUCTION

The new wave of growing awareness in country for nutrition value of foods has made widespread concern about the diet we intake. As the primary role of a diet is to provide sufficient nutrients to meet metabolic requirements while giving the consumer a feeling of satisfaction and well-being<sup>[1]</sup>. Diet may modulate various physiological functions and may play detrimental or beneficial roles in some diseases<sup>[2]</sup>. There is a threshold of a new frontier in nutrition sciences and indeed. In the Western world, concepts in nutrition are expanding from the past prominence on survival, hunger satisfaction and prevention of adverse effects to an emphasis on the use of foods to promote a state of well-being, improve health, and reduce the risk of diseases<sup>[3]</sup>. These concept are particularly important in light of the increasing cost of health care, life expectancy and also to improve quality of life. Background Historically, the nutritional state of populations is affected by high intake of sugars, salt, saturated and trans-fatty acids, low intake of fibers, vitamins, and essential minerals<sup>[4]</sup>. These habits are the main causing problems of non-transmissible chronic-degenerative diseases. To reduce the such type of illness, the Development of new food products contain some biological substances has been proposed

by Roberfroid 2002. Initially, functional food is define by japan during 1980s for the specific health use (FOSHU)<sup>[5]</sup>. The Worldwide accepted definition, Functional food is coined to describe foods or nutrients whose ingestion leads to important physiological changes in the body that are separate and distinct from those associated with their role as nutrients (FDA 2004). In this way, Functional food was introduce which have curing effects of food beyond nutritional value<sup>[6]</sup>. Functional food that are developed recently in all over the world are Probiotic, Prebiotic and Symbiotic as well as foods enriched with antioxidants, isoflavones, phytosterols, anthocyanins and fat-reduced, sugar-reduced or salt-reduced foods. Among all these, Probiotic functional food gave the positive effect on the overall health. Probiotics are divided into two ways: Probiotic dairy foods and Probiotic non dairy foods. Probiotics are in demand and the increased demand for dairy probiotic products comes from the health promotion effect of probiotic bacteria which are originally initiated from milk products, bio active compounds of fermented dairy products and prevention of lactose intolerance<sup>[7]</sup>. Probiotics as Functional Foods: Definitions According to Fooks and others (1999), the word probiotic

derives from 2 Greek words<sup>[8]</sup> that mean for life. This term was 1st used to describe a microbial substance that stimulated the growth of other microorganisms or tissue extracts that promoted microbial growth, but it did not receive general acceptance. Probiotic, Contains live microorganisms that effects the host in a health way, balancing the intestinal flora is define by Fuller(1989)<sup>[9]</sup>. Many other definition of probiotic are published but widely accepted definition is "probiotic are live microorganisms, administrated in certain quantities that confer health benefits to the host" (FAO/WHO 2001). The majority of probiotic products available in the marketplace contain species of *Lactobacillus* and *Bifidobacterium*, which are the main genera of Gram-positive bacteria currently characterized as probiotics (FAO/WHO 2001). Different species of Probiotic are *Lactobacillus acidophilus*, *L. casei*, *L. johnsonii*, *L. rhamnosus*, *L. thermophilus*, *L. reuteri*, *L. delbrueckii subsp. Bulgaricus bulgaricus*, *bifidobacterium bifidum*, *B. longum*, *B. brevis*, *B. animalis*. *Lactobacillus bulgaricus* and *streptococcus thermophilus* are found in a number of preparation like yoghurts, frozen yoghurts and desserts<sup>[10]</sup>. There are some ideal properties of the probiotic strains<sup>[11]</sup> that would benefit human health and could be used in the probiotics industry. These

include resistance to: a) Acid and bile; attachment to the human gut epithelial cells b) Colonization in the human intestine c) Production of antimicrobial substances, including bacteriocins d) Good growth characteristics and beneficial effects on the human health e) It must be nonpathogenic and generally regarded as safe (GRAS). f) Probiotics must also present some desirable characteristics, such as maintenance of viability during processing and storage, ease of application in products, and resistance to the physicochemical processing of the food<sup>[12]</sup>. It is important to report that these bacteria should be present in a dairy food to a minimum level of 10<sup>6</sup> CFU/g or the daily intake should be about 10<sup>8</sup> CFU/g, with the aim to compensate for the possible reduction in the number of the probiotic microorganisms during the passage through the gut<sup>[13]</sup>.

Dairy probiotic foods Dairy functional foods beyond its basic nutritional value has physiological benefits. Milk has an outstanding position foods because it has omega-3, phytosterols, isoflavins, linolenic acid, minerals and vitamins<sup>[14]</sup>. Dairy product such as ice cream, yoghurt, cheese, milk, kumis and kefir containing probiotics<sup>[15]</sup>.

Table 1. Microorganisms applied in probiotic products

Lactobacillus species	Bifidobacterium species	Other Lactic Acid bacteria	Non-lactics
<i>L. acidophilus</i> (yoghurt)	<i>B. adolescentis</i> (fermented milks)	<i>Enterococcus faecalis</i>	<i>Bacillus cereus</i> (infant food)
<i>L. casei</i> (cheddar cheese )	<i>B. animalis</i>	<i>E. faecium</i>	<i>Escherichia coli</i>
<i>L. crispatus</i>	<i>B. bifidum</i>	<i>Lactococcus lactis</i> (buttermilk and cheese)	<i>Propionibacterium</i>
<i>L. gallinarum</i>	<i>B. breve</i>	<i>Leuconostoc mesenteroides</i>	
<i>L. gasseri</i>	<i>B. infantis</i>	<i>Pediococcus acidilactici</i> (fermented vegetables, fermented dairy products and meat.)	
<i>L. johnsonii</i>	<i>B. lactis</i>	<i>Sporolactobacillus inulinus</i>	
<i>L. paracasei</i>	<i>B. longum</i> (dairy products)	<i>Streptococcus thermophilus</i>	
<i>L. plantarum</i>			
<i>L. rhamnosus</i> (yoghurt, cheese)			
<i>L. reuteri</i>			

## PROBIOTIC ICE CREAM

Probiotic ice cream can be produced by incorporation of probiotic bacteria in both of fermented and unfermented mix. Ice cream is a good food to deliver microorganism in the human diet. *Lactobacillus* and *Bifidobacterium* are the most common species of lactic acid bacteria used as probiotics for fermented dairy products. Among all the frozen dairy products ice cream is gaining popularity because of the neutral pH<sup>[16]</sup>. The pH of non-fermented ice cream is seven which is providing to survive probiotic bacteria. The high total solid level in ice cream including fat and milk solids provide protection for the probiotic bacteria<sup>[17]</sup>. Because the efficiency of added probiotic bacteria depends on<sup>[18]</sup> dose level, type of dairy foods, presence of air and low temperature, their viability must be maintained throughout the product's shelf-life and they must survive the gut environment.

## PROBIOTIC CHEESE

Various types of cheese have a good potential to maintain the probiotic survival. It is also a good source like ice cream to transfer probiotics into human intestinal tract. There are two ways for development of probiotic cheese<sup>[19]</sup>: a) In the first step, the manufacture processes of cheese products may have to be modified and adapted to the requirements of probiotics b) In second step, appropriate probiotic strains may be applied or new cheese products may have to be developed. In probiotic cheese, probiotic cells must be able to grow and multiply into human intestinal tract (GIT), which involves exposure to hydrochloric acid in stomach and bile in small intestine. It create high acidic environment for probiotic survival throughout the gastric transit, ought to higher pH.

## PROBIOTIC YOGHURT

Yoghurt has been historically recognized to be a healthy food with therapeutic effects<sup>[20]</sup>. The conventional yoghurt starter bacteria, *L. bulgaricus* and *Streptococcus thermophilus*<sup>[21]</sup> do not have ability to survive passage through intestinal tract and consequently so, they are not considered as probiotics. But the addition of *L. acidophilus* and *B. bifidum*<sup>[22]</sup> into yoghurt can add extra nutritional and physiological values. The survival of probiotic bacteria in fermented dairy products depends on physiological state of probiotic organisms added (cells are added from which phase stationary phase, log phase), the chemical composition of the fermentation medium (e.g. carbohydrate source), final acidity, milk solids content,

availability of nutrients, growth promoters and inhibitors, strains used, interaction between probiotic and starter culture (antagonism, synergism, bacteriocin production)<sup>[23]</sup>, culture conditions, concentration of sugars (osmotic pressure), dissolved oxygen (especially for *Bifidobacterium* spp) During fermentation, pH levels when the lactic acid content increases. 'over acidification' or 'post acidification' is due to decrease in pH after fermentation and during storage at refrigerated temperature. The 'over acidification' can be prevented to a limited extent by applying good manufacturing practice and by using culture with reduce 'over acidification' behavior<sup>[24]</sup>. Viability of both *Lactobacillus* and *Bifidobacterium* species reduces at low pH levels<sup>[25]</sup> during refrigerated storage. So, strain selection and survival are necessary to produce high quality bio yoghurt<sup>[26]</sup>. PROBIOTIC MILK The probiotic milk is to market in liquid form. During fermentation, milk pH often goes beyond the narrow range of optimal pH of *Lactobacillus acidophilus* (5.5-6.0)<sup>[27]</sup>. *Lactobacillus acidophilus* is added as active bulk culture. As the milk lactose is hydrolyzed by  $\beta$ -galactosidase of *Lactobacillus acidophilus*, *acidophilus* milk<sup>[28]</sup> is more suitable for individuals suffering from lactose intolerance. It is also possible to enrich with calcium, iron and vitamin. Undesirable sour milk flavor caused by *acidophilus* milk is gained limited popularity by consumers. When *Lactobacillus acidophilus* is incorporated into pasteurized milk at about 5°C and bottled aseptically, these bacteria are able to keep their viability up to 14 days without reducing the pH of milk due to it does not grow at low temperatures (<10°C).

## DAIRY PROBIOTIC AND THEIR SENSORY QUALITIES:

The success of sensory evaluations regarding probiotic products (dairy and nondairy) depends on the methodology applied and the inclusion of similar non probiotic products in the test to obtain scientific sound results and also to analyze the main positive/negative points of the food product.<sup>[29]</sup> Sensory properties of probiotic yoghurt The affective (acceptance) tests related that there were differences among the yoghurts, suggesting that the level of preference increased with an increase in the proportion of açaí pulp<sup>[30]</sup> in the yoghurt formulation. The main attribute is color and flavor.

## SENSORY PROPERTIES OF PROBIOTIC BEVERAGES

Sensory properties of probiotic fermented beverages are the most traditional and consumed probiotic media for dairy non dairy beverages. Sensory analysis of the açaí- containing probiotic whey beverage<sup>[31]</sup> with *B. longum* BI-05 and *L.*

*acidophilus* La-14 corresponding to "extremely better than the standard" and "slightly better than the standard," which had no probiotic bacteria<sup>[32]</sup>. Strawberry flavored probiotic dairy beverages with whey in their formulation were produced and sensory evaluation was done<sup>[33]</sup>. The sensory acceptance results of a fermented probiotic goat milk drink containing *L. acidophilus* and B. BB-12 shows that fermented goat milk supplemented with 3% WPC showed high overall acceptability, similar to cow fermented milk.

#### PROBIOTIC ICE CREAM AND DESSERT

Sensory properties of probiotic ice cream and desserts are food products that shows great potential for use as vehicles for probiotic culture consumed by all age groups. Probiotic culture added in two ways, considering they are of the DVS type means direct addition to the product during manufacturing. Adding them directly to the pasteurized mix or using milk as a substrate for fermentation, producing, in the latter case, frozen yoghurt ice cream<sup>[34]</sup>. In second case, the pH must be closely controlled during the fermentative process from the moment of obtaining the inoculum and also the temperature.

#### SENSORY PROPERTIES FOR PROBIOTIC CHEESES

Another medium for probiotic incubation is cheese. Its versatility offers opportunities for many marketing strategies as a probiotic carrier. However, the development of probiotic cheeses<sup>[35]</sup> implies obligatory knowledge<sup>[36]</sup> of all their processing steps, as well as on their level of influence (positive or negative) on the survival of these microorganisms, sensory acceptance, chemical stability, and microbiological conditions throughout their shelf life. The impact of probiotic bacteria on flavor characteristics of cheese is mainly depend on the species and strains added<sup>[37]</sup>. Also it depends on the metabolic activity of strains during production and storage. Many investigators indicate that addition of probiotic bacteria to cheese in a suitable culture composition does not affect the flavor or sensory characteristics of final product. For example it has been reported that bifidobacteria added to cheddar cheese does not exhibit vigorous metabolic activity and hence did not affect the flavor<sup>[38]</sup>. Lactic acid percentage is higher of probiotic cheese<sup>[39]</sup>. Vacuum-packed probiotic cheese had the highest level of proteolysis and the highest sensory scores of all cheese<sup>[40]</sup>.

#### CONSUMER ATTITUDE TOWARD FUNCTIONAL DAIRY FOODS

The development of functional probiotic foods is increasing, as their market increases day by day, although the consumer's

information<sup>[41]</sup> about these foods is increasing without any relation to gender, age, and educational or economic levels of the consumers. The functional probiotic food may depend on the consumers and the type of carrier and enrichment considered. For instance, yoghurt is most preferred by its enrichment with calcium and fiber<sup>[42]</sup>. The sensory properties sensory properties such as rounder mouth feel, reduced aftertaste, and slight sweetness to of probiotic functional foods in comparison with conventional products can lead to different acceptance level<sup>[43]</sup>. These properties are responsible for high score values for taste, creaminess and overall acceptability.

#### CONCLUSION

Development of probiotic food is an expensive and multistage process that takes into account many factors, such as sensory acceptance, physical and microbial stability, price, and chemical and other intrinsic functional properties to be successful in the marketplace<sup>[44]</sup>. The future success of functional probiotic dairy foods in marketplace depends on consumer acceptance (food safety, sensory appeal, brand, marketing, and others) of such products. The consumer must be convinced by its health claims through clear, honest and definite message to agree to pay the cost convinced by its health claims<sup>[45]</sup>. However, it is a challenge to develop probiotic and other functional foods<sup>[46]</sup> that can both indulge consumers' eating desire while also providing potential health benefits.

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