Indian perspective for probiotics: A review

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Abstract In short span, probiotics (a greek word "for life") have become an integral part of the complex world as biologics, pharmaceuticals, food and nutritional supplements due to their potential of providing health benefits. These acts as food supplements as well as preventive or curative drug which contains live non pathogenic bacteria. It is mainly the bacteria and metabolites produced by them which impart these probiotics their health promoting properties. In recent years, there has been a growing awareness among Indian consumers about the importance of nutrition, health, and quality of food they eat. Consumers are attaching more significance to healthy diet than physical activities. They are switching towards health supplements which could have deleterious effect. In modern day lifestyle, the market has witnessed an increase in sale of health products amongst the health conscious consumers globally creating new health food categories. At present, the probiotics is at nascent stage and awareness as food supplement is limited to urban areas. The knowledge about their use and technology to prepare them in a convenient form for domestic use have to be imparted in the Indian rural areas as an affordable product mainly within the lower income group people. Regular use of probiotics could improve the quality of life and reduces the dependence on drugs and medical expenses. This review keeping in mind the Indian scenario aims to evaluate the health benefits of probiotics in food and pharmaceutical sectors, the existing knowledge in rural population and the current Indian market for probiotics.

Keywords: Probiotics, health benefits, awareness, India

Introduction

The importance of probiotics is known across civilizations and strata of societies over centuries in the form of practice of consuming preserved foods obtained through the process of fermentation. Since ages, traditional fermentation processes, using locally available ingredients, which may be of plant or animal origin, are converted into edible products by the physiological activities of microorganisms (Steinkraus 1996). The traditional fermented foods are mainly obtained from dairy products viz. yoghurt, dahi, kefir, cheese (after long storage), fermented vegetable or from vegetable juices and from non fermented fruit and berry juices. Indigenous fermented foods have been prepared and consumed for thousands of years, and are strongly linked to culture and tradition. Amongst Asian countries, the most prominent ones which consumes probiotics are Japan, Korea, Indonesia, India, Nepal, Sri Lanka. The Japanese consumes it in the form of Nato and Miso, a fermented soybean used as a condiment, while, in Indonesia, it is known as Tempeh and Koreans consumes spicy fermented condiment made from various vegetables mainly napa cabbage, Kimchi. In India, idli, dosa, dhokla, khaman are certain popular traditional fermented foods which are consumed throughout India, particularly in southern and western parts of India. At certain times, sour buttermilk or yeast is added in order to enhance fermentation. Leuconostoc mesenteroides, Streptococcus faecalis and Pedicoccus cerevisiae are the significant microorganisms involved in the fermentation process (Parashothaman et al. 1977). In eastern Himalayan regions of Darjeeling hills and Sikkim, a product of fermented soybean is consumed. Bacillus subtilis is the predominant microorganism in cinema. Enterococcus faecium, Candida parapsilosis and Geotrichum candidum are also involved. In certain parts of India, fermented rice (prepared by addition of water to cooked rice followed by overnight incubation and then water was drained off) was mixed with buttermilk and salt for direct consumption. The jalebis and kanji are mainly consumed by northern India. Amongst the dairy products,
dahi, rabdi, paneer, shririkhand, misti dahi and chhurpi, are used in northern, western, eastern and Himalayan region of India, respectively. Indigenous people of eastern Himalayan regions of Darjeeling hills and Sikkim use the fermented bamboo shoot product called mesu as pickle and base of curry. Khalpi is a traditional cucumber pickle used in the Himalayan region of India. These fermented products are consumed unknowingly as, probiotic food or drink, by local people from ages due to enormous health benefits associated with them and has now been realized. The organisms that are best studied and generally regarded as probiotics are species of the bacteria Bifidobacterium, Lactobacillus, and Streptococcus, and also including yeast such as Saccharomyces boulardii (Vanderhoof 2000; Wescombe et al. 009).

In today's modern world, due to urbanization and change in dietary habits and lifestyle pattern has itself forced the health conscious consumers to search for an alternative treatment regime for various ailments caused by lifestyle related diseases. The consumption of probiotics exerts myriad of beneficial effects which is evidenced by rigorous scientific evaluation. Promotes proper digestion, a strong immune system, restores gut microflora, improves barrier function of gut epithelium, modifies inflammatory response, aids in treating diarrhea originated due to traveling or during antibiotic course or upsetness of gastrointestinal tract, prevents ulceration caused due to helicobacter pylori (Kumar et al. 2012; Parvez et al. 2006), and aids in assimilation of nutrients from our food and supplements, in particular B vitamins and omega-3 fatty acids. These health benefits initiated the research to support the concept that there are clinical health benefits to ingest these micro-organisms (Guarner and Schaafsma, 1998). It is a major focus of attention of scientists across the world due to their promising health benefits and their applications offers an innovative approach for development of novel probiotic formulations.

The article reviews the reports available on probiotics, illustrates how probiotics functions in human ecosystems, and outlines the global market scenario of probiotics with emphasis in the Indian context. The paper also addresses the Indian consumer's psychology for probiotic products, targeted customers and statistics of the consumption of dairy products in India. The present study also reviews the health benefits and the impact of probiotics on human health and diseases supported by clinical evidences. Besides this, potential strategies for increasing probiotic market in India, current scientific research on indigenous strains of probiotic bacteria and futuristic approach for probiotics in terms of research and development are also discussed in the light of current literature. At the end, authors concluded that probiotic has shown a lot of potential in aiding number of diseases and in the existing situation, excellent growth opportunities are stored for both domestic as well as for foreign companies to venture their capital in the probiotic industry.

Probiotics

The term probiotic means ‘pro-life’ or ‘for life’ in Greek. Probiotics are live microorganisms which are present naturally in our surroundings, our skin, digestive tract, nasal tract, urinary tract, genital area, mouth, etc., Not all bacteria are harmful, some bacteria are not only beneficial but are needed for some of our body functions.

As per to the existing rules and regulations of each country; probiotics is not considered under a single category rather it is subcategorized under different categories according to their intended usage. It is either categorized as probiotic drugs, probiotic food (e.g., foods, food ingredients, and dietary supplements), probiotics for animal use and genetically modified probiotics. In India, probiotic foods come under the functional foods category. Functional foods are defined as products that are similar in appearance to conventional foods and are consumed as part of a normal diet and have demonstrated physiological benefits, and/or have the potential to reduce the risk of chronic disease beyond nutritive function, i.e. they contain bioactive compounds. The Indian Council of Medical Research and Department of Biotechnology have formulated guidelines for probiotics being marketed in India. These guidelines specify the criteria that need to be borne

<table>
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<tr>
<th>S.No.</th>
<th>Country</th>
<th>Category</th>
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<tbody>
<tr>
<td>1</td>
<td>Denmark/Sweden/Finland</td>
<td>Food Supplements</td>
</tr>
<tr>
<td>2</td>
<td>Canada</td>
<td>Natural health products</td>
</tr>
<tr>
<td>3</td>
<td>Italy</td>
<td>Dietary food</td>
</tr>
<tr>
<td>4</td>
<td>European countries/Belgium/Germany</td>
<td>Biotherapeutic agents</td>
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<tr>
<td>5</td>
<td>Japan/India/China/Malaysia</td>
<td>Functional food</td>
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<tr>
<td>6</td>
<td>USA</td>
<td>Dietary supplements/ Drugs/ Live Biotherapeutic agents/ Medical food</td>
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when launching a probiotic food in the country (Ganguly et al., 2011). Probiotics subcategories in different categories country vs category (Table 1)

How do probiotics function in body?

- Inhibit growth or reduce the activity of bad bacteria in intestine by colonizing the gut
- Having antimicrobial activity and aid in increasing our immunity by making our body more resistant to diseases and infections.
- Improve the secretion of digestive enzymes and helps in proper digestion.
- Increase the production of lactic acid and regulates pH balance in intestine and other parts of body.
- Promote acidic pH which facilitates the absorption of protein and minerals like calcium, copper, magnesium, iron and manganese.
- Having anti-inflammatory properties
- It could ferment fructo-oligosaccharides which thereby results in reduced pH balance. This increases acidity in gut thereby enabling better absorption of calcium and allow it to get into blood stream.

Historical background of probiotics

The first probiotic was fermented milk for human consumption. Since vedic times, the role of fermented milk in human diet was realized. But, the scientific interest in this area was initially recognized by Metchnikoff in the early 1900s. According to his hypothesis, the long life of Bulgarian peasants was attributed to their consumption of large quantities of ‘sour milk’ containing Lactobacillus bulgaricus. He believed that the beneficial effect was due to the ability of probiotics to replace the already existing harmful microorganisms that are present in the gut. Later in 1930’s, using the Metchnikoff’s concept for probiotic microorganisms, the commercial exploitation of probiotics for health benefits was credited to the Japanese scientist Shirata who could successfully isolate and used L. casei Shirata in order to consume the widely consumed probiotic product under the brand name of ‘yakult’ (Shida and Nomoto 2013). This probiotic drink is safe to use and is backed by preclinical and clinical studies showing health benefits. Currently, there are numerous products of various origins and forms containing different microorganisms which are available in the market. The term "probiotics" was initially coined by Lilly and Stilwell in 1965 and is defined as the substance being secreted by one organism which stimulates the growth of another (Lilly and Stillwell 1965). This definition was modified over the years to keep with the pace of the existing knowledge on probiotics.

The most widely accepted definition for probiotics was given by FAO/WHO (2001) for probiotics is that for any strain/ product to be classified as a probiotic it must be or must contain live microorganisms in specific number (generally numbering one billion) which are resistant to gastric acid, bile and pancreatic juices and reach the target site (small intestine/large intestine) in numbers sufficient enough to elicit a beneficial effect. It should be scientifically validated through well controlled clinical trials (FAO 2001).

Global probiotic market

The probiotics market is a lucrative market from the perspective of functional food suppliers and manufacturers. According to one of the market report source from Transparency Market Research (2013) titled "Probiotics Market (Dietary Supplements, Animal Feed, Foods & Beverages) - Global Industry Analysis, Market Size, Share, Trends, Analysis, Growth and Forecast, 2012 - 2018", which mentions that the global probiotic demand was $27.9 billion (2011) and is expected to reach $44.9 billion in 2018 at a CAGR of 6.8%. The global demand for probiotics is dominated by Asia-Pacific and Europe, while, Asia-pacific is expected to be the prominent player in near future with an expected CAGR of 7.0% from 2013 to 2018. In Asia-Pacific, China and Japan dominates the market revenue for probiotics,

Table 2 : The commercially used live cells as probiotics by different companies

<table>
<thead>
<tr>
<th>Strain</th>
<th>Country</th>
<th>Company</th>
</tr>
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<tbody>
<tr>
<td>Lactobacillus rhamnosus GG</td>
<td>Finland</td>
<td>Valio Dairy, Helsinki</td>
</tr>
<tr>
<td>Lactobacillus johnsonii LAL</td>
<td>Switzerland</td>
<td>Nestle, Lausanne</td>
</tr>
<tr>
<td>Lactobacillus casei Shirata</td>
<td>Japan</td>
<td>Yakult, Tokyo</td>
</tr>
<tr>
<td>Lactobacillus acidophilus</td>
<td>USA</td>
<td>Rhodia, Madison</td>
</tr>
<tr>
<td>Lactobacillus casei DN 014001</td>
<td>France</td>
<td>Danone</td>
</tr>
<tr>
<td>Lactobacillus delbruekii</td>
<td>Japan</td>
<td>Meiji Milk Products, Tokyo</td>
</tr>
<tr>
<td>Saccharomyces boulardii</td>
<td>USA</td>
<td>Biocodex, Seattle</td>
</tr>
<tr>
<td>Bifidobacterium longum BB536</td>
<td>Japan</td>
<td>Morinaga Milk Industry</td>
</tr>
</tbody>
</table>

Source: Raja and Arunachalam (2011)
with India and other regions also showing significant growth. While, in Europe, Germany and U.K. are the most attractive markets, with an expected CAGR of over 6% each from 2013 to 2018. The probiotic foods and beverage are the dominant segments among probiotics and is estimated to reach $37.9 billion in 2018; followed by this, the market for dietary supplements and animal feed are also witnessing significant growth. Dairy products are the largest application market for probiotic foods and are estimated to reach USD 32.2 billion in 2018. The new segment under animal feed has emerged which is estimated to cross USD 3 billion (2018).

It is expected that pricing issues, culture cultivation and lack of standardization of product specifications are expected to have an inhibitory effect on market growth. The commercially used live cells as probiotics by different companies are mentioned in Table-2.

Current market of probiotics in India

In the present scenario, India accounts for less than 1% of the total world's market under probiotics segment. Currently, most of the probiotics products available are predominantly dahi (Indian yogurt) and a few probiotic beverages such as flavored milk, fermented and unfermented milk and butter milk. But, the market has expanded beyond these most common probiotic products and the new entrants are juices, smoothies, cereal, nutrition bars and infant/toddler formula. In India, the per capita consumption of the packaged, store-purchased dahi has increased from 1 kg in 2000 to 1.4 kg in 2017, making it one of the fastest growing categories under the packaged food segment. This is contributing to a surge in the demand for probiotic food products in the Indian market. The probiotic food and beverage market in India is expected to grow at a CAGR of 20-25% with the introduction of a fermented milk beverage called Nutrifit (contains dietary fiber) and thereafter it was launched nationally in a phased manner.

While, mother dairy has introduced Pro Actiplus Dahi with a starting price of Rs. 10 and declared that their products contains dietary fiber. The company expanded the range with the introduction of a fermented milk beverage called Nutrifit in two flavors, mango and strawberry. They have a wide distribution network in Delhi and Mumbai, Saurashtra and Hyderabad.

Nestle brings out a probiotic dahi called Actiplus dahi. According to the company, every 100g serve of the dahi has over 100 crore probiotics, which help the digestive system if consumed daily. Tablets India, on the other hand, has established itself as a major brand in Probiotic drug and dietary supplement market.

Danone launched its creamy stirred yogurt in 2011 to target the health-conscious population in India, in three flavors - plain sweet, strawberry, and pineapple, at outlets in Delhi/NCR, Mumbai, Pune, Hyderabad, and Bangalore.

In this direction, Britannia after a huge success of their product, Daily Fresh Dahi have entered with a pioneered product in this segment by launching flavored yogurt in three flavors, mango, vanilla and strawberry fortified with 5 active nutrients, viz., iron, iodine, calcium, zinc and vitamin A. This includes Mother Dairy, Amul, Danone Yakult, Nestle, Tablets India, Dr Reddy Laboratories, Unique Biotech, Zeus Biotech, etc.

Mother Dairy has the dominant position in the Indian probiotic functional food and beverage market, followed by Amul. These companies are contributing lot to probiotics dairy products and due to urban population's acceptance to these products are helping to increase companies focus to produce more and more probiotic products.

In this segment, Amul pioneered to introduce Prolife Probiotic Ice Cream, Sugar Free Prolife Probiotic Ice Cream, followed by Prolife Lassi (as sachets and in plastic cups) in 2007. In 2011, it introduced Flaavyo Fruit Yoghurt, which includes fruit-based flavors like Mango, Strawberry, Pineapple, and Vanilla, and also Mishti Doi (Sweet Curd) and in 2014, it has launched Flaavyo Frozen Yoghurt.

In this league, in 2007, Yakult Danone India Pvt Ltd (YDIPL), a 50:50 joint venture company between Japan's Yakult Honsha and The French- Danone Group, has offered yakult, a fermented milk drink which contains more than 6.5 billion beneficial bacteria (Lactobacillus casei strain Shirota) in a 65 ml bottle priced at Rs 10 and is available in the pack of 5. These bacteria reach our intestine alive and impart various health benefits. Initially, yakult was available only in Delhi and thereafter it was launched nationally in a phased manner.

According to the reports of Research and Market (2014), India's probiotic market is projected to grow at a CAGR of around 19% till 2019. Functional dairy products with probiotics are promising in the Indian market, as major players engaged in offering probiotic food products in the Indian market includes Mother Dairy, Amul, Danone Yakult, Nestle, Tablets India, Dr Reddy Laboratories, Unique Biotech, Zeus Biotech, etc.
product is available in Mumbai, Delhi, and Bangalore.

The market for products containing probiotics is expected to grow as Indians become more aware of natural, healthy ingredients in foods. The probiotics were launched in India in 2007 and at present the Indian probiotic industry is valued more than $10 million. In current scenario, the Indian market's contribution to the world's demand for probiotics, however, is less than one per cent in terms of turnover. The Indian probiotic industry is miniscule and at a very burgeoning stage. Currently, it stands at about Rs 50 crore and is growing at 20 per cent.

Major pharmaceutical companies have become active and are trying to formulate newer drugs and products, and packaged products like probiotic-based nutritional supplements with special needs such as lactation, pregnancy, immunodeficiency etc and products especially for pediatric and geriatric patients. In this aspect, some probiotic based pharmaceutical formulations are Sporolac, VIlbact, Darolac, Biglac, Bilflac etc. Currently, probiotics are often used as animal feed supplements for cattle, poultry and piggery. This requirement is also met by importing probiotics from other countries. The most commonly found commercial probiotic drinks for human consumption are found in the form of probiotic drinks, ice creams and frozen desserts. The latest and recent addition to the list of probiotics in India is VIlbact (which is made up of genetically modified Bacillus mesentricus), which acts as an alternate to B-complex capsules (Somal et al. 2008). Probiotic products are gaining acceptance mostly in metros and in some Tier I cities. The Indian market is big, but difficult to reach since cold storage and cold distribution chain are underdeveloped in India, especially in the rural areas. Realizing these drawbacks, yakult has taken an initiative in this direction, and has already announced to target tier II cities in their next phase. The strongest sale of Yakult is recorded from Delhi/ NCR. In the future, it is important to increase the awareness of the country people and to educate them about the probiotics' benefits.

Consumer Psychology

At present there is a slow growth in terms of sales of probiotic products, this could be attributed to the cultural differences between the western world and India. Many people believe that "probiotic yogurt" is simply a marketing tool used by dairy and yogurt companies. In India, dahi is a part of the daily diet and could be prepared easily at home due to optimal environmental conditions, while in many western countries, curd is a specialty and is bought from supermarkets so consumers in western countries considered it as revolution and actively look forward for a newer and better version of curd/yogurt for maintaining a balanced gut flora towards optimal health compared to Indian consumers who believe that it is not resourceful to spend more for such products and have a confusing entity that what make these products different from traditional foods.

The product's acceptability depends on many factors for selecting, consuming and reusing it and it's not only the sensory characteristics of food which determines its acceptance. The other factors include the claims and features of the product, such as health benefits and the knowledge of the functional ingredients present in the product (Jaeger, 2006). In the past few years, more and more consumers are getting health conscious, this change in consumers behavior is indicated by the growing interest in consuming "healthier" foods (Vidigal et al. 2011). Amongst the new and exciting concepts related to the foods whose health claims have been disclosed in recent years, probiotic foods are highlighted. Probiotics are living microorganisms which when administered in adequate amounts confer health benefits to the host (FAO/WHO 2002). At present, there is limited information available with consumer regarding the benefits of probiotic foods. The main target of the food industry should be to understand the consumer's thoughts, beliefs, feelings and behavior so as to hold a good percent share in market by obtaining positive attitude and consequent acceptance of their product by the consumers.

Customer segmentation for usage of probiotics

India with an increasing awareness and need for preventive medicine is also witnessing the entry of a surge of probiotic foods which are rapidly finding their way onto the market shelves (Hajela et al. 2010). The existing probiotic market in India majorly comprises of three segments, urban chain mainly the elite and middle class population having tendency to self medicate aids in the growth of probiotic industry. Besides this, young adults and people with special needs such as pregnancy, lactation, immunodeficiency, pediatric patients and lifestyle diseases such as diabetes, obesity, anaemia etc spend on probiotics. An increase in disposable income of Indian population is another driving force which acts in favour of probiotic industry. The population statistics clearly reveal that of the 121 crore Indians, 83.3 crore live in rural areas while 37.7 crore stay in urban areas, said the Census of India's 2011 Provisional Population Totals of Rural-Urban Distribution in the country, released by Union Home Secretary RK Singh (articles.economictimes.indiatimes.com). This data shows that nearly 70% of the country's population lives in rural areas. Till date, only 30% of the population has an easy access to the probiotic products. The most common problems rural India faces are poor sanitary conditions and limited health facilities in terms of unavailability of modern medicine. Due to improper hygienic conditions, there is a concomitant outbreak of intestinal diseases. In this direction, there is a need to develop a simple and accessible method to improve the quality of these economically challenged people. At present, difficulty is faced for the distribution of fermented dairy products in rural areas. Some Tier I cities, the Indian market is big, but difficult to reach since cold storage and cold distribution chain are underdeveloped in India, especially in the rural areas. Realizing these drawbacks, yakult has taken an initiative in this direction, and has already announced to target tier II cities in their next phase. The strongest sale of Yakult is recorded from Delhi/NCR. In the future, it is important to increase the awareness of the country people and to educate them about the probiotics' benefits.

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India due to unreliable cold distribution chain. The solution could only be to provide people with lyophilized or spray dried bacterial strains. At present, there are technological challenges to prepare an affordable and an effective bacterial strain (starter of fermentation) which is of no interest for the industry.

The trend for dairy product consumption in India is high, since majority of population is vegetarian-based (around 500 million or ~41% of the total population) (http://www.vegetarians.co.nz), and dairy products are the sole source of proteins to fulfill the deficiency caused due to absence of meat in diet. The per capita consumption of dairy products in rural areas (~36%). In certain individuals and in many aged people, the level of endogenous enzyme declines and causes lactose intolerance and the condition manifests with clinical symptoms such as bloating, flatulence, nausea, abdominal pain and diarrhea. In this respect, probiotic strains may decrease the symptoms of lactose intolerance by producing their own secreted β-galactosidase or by consumption of lactose during the fermentation.

According to the Indian statistical report, more than 50% of India's population is below the age of 25 and over 65% is below 35. India's youth either in urban or in rural India represents a huge market opportunity for any new health and wellness product. At present, the Indian youth have hectic working lifestyles and shift in food habits from homemade food to readymade processed food which creates an opportunity for probiotic manufacturers.

Dairy product consumption in India

As per NDDB, the Indian dairy industry is all set to experience high growth rates in the next eight years with demand likely to reach 200 million tonnes by 2022 from 132 million tonnes in 2013. Presently, only 20% of the milk production comes from the organized sector comprising co-operatives and private dairies.

The paramount factors driving the growth in the dairy sector include rising disposable incomes, advent of nuclear families and fast/ instant food gaining ground in India. Other factors such as structural changes in food habits, expansion of fast food chains and popularity of pizzas and pastas aided the usage of milk variants of mozzarella cheese, processed cheese and flavored milk etc. Market share of milk and milk products in FY 13 in terms of total sales value (Fig.1)

Health benefits of probiotics

The probiotics have shown to beneficially affect the host by improving its intestinal microbial balance through lowering of pH to provide a hostile environment for pathogens and yeasts, improves nutrient absorption/assimilation from food and digestion, stimulates and balances the immune system, prevents vaginal and urinary tract infections, prevents and treats side effects of antibiotic therapy, aids in digestion of lactose and dairy products by reducing lactose intolerance, helps in the regulation of bowel movements, reduces the toxic load of liver, inhibits the growth of bacteria which produces nitrates in bowel, since production of nitrates could in certain cases causes cancer, prevents the overgrowth of disease causing microbes such as Candida, E. coli, Helicobacter pylori and Salmonella, reduces the incidences of yeast infections, virginities and candidacies, calms down the colon irritation following surgery, supports healthy skin in youth primary bacteria in infants, which helps them to grow and develop their immune system, therapeutic for upper respiratory complaints, act as remedy for bad breath (halitosis), increased ability to synthesize vitamin B, manufactures vitamin B complex, increases the ability to absorb calcium, reduces the occurrence of bladder cancer, prevents and manages atopic dermatitis (eczema) in children.

Clinical evidences supporting health claims for probiotics

a) Lactose intolerance: Individual's suffering from this condition lack the enzyme lactase and is unable to digest lactose sugar present in dairy products. In this respect, yogurt promises to be an alternative to milk (Kolars et al. 1984). In a study, researchers observed that lactose intolerant subjects consuming 18 gram of lactose in the form of yogurt could digest and absorb lactose efficiently than those who receive same amount of lactose from milk. Besides this, improved lactose tolerance in yogurt group also led to less diarrhea.
and other gastrointestinal symptoms. Through this study, researchers concluded that probiotics in yogurt helps in the release of β-galactosidase, an enzyme involved in lactose breakdown/digestion (Rosado 1996).

b) Aids in calcium absorption: Studies have shown that milk contains abundant amount of calcium apart from other dietary sources. The individuals suffering from lactose intolerance may develop osteoporosis due to decreased consumption of milk in diet. In such cases, if probiotics (curd, yogurt or fermented milk) are fed to lactose intolerant individuals, milk lactose is hydrolyzed by probiotic strains and thereby favors calcium absorption (Vandenplas and Benniga 2009).

c) Antibiotic associated diarrhea: In one of the post by Nicole Cunningham (2014) in Puraforce Remedies, mentioned that there are two sides of the biotic coin, on one side antibiotics and then there are probiotics. If antibiotics are consumed for any reason then in order to counteract their effects, probiotics 'friendly bacteria' have to be consumed to fight illness and diseases so that chances to consume antibiotics is reduced to a certain extent. Antibiotics could not differentiate between good and bad bacteria. In turn both organisms are killed and due to the suppression of good bacteria, immune system as well as digestion suffers. Armuzzi and coworkers in two different studies involving 60 and 120 adult patients reported that subjects who simultaneously received Lactobacillus GG along with antibiotics for the elimination of Helicobacter pylori, had significantly lower chances of experiencing nausea and diarrhea versus placebo. Besides this, Marchand and Vandenplas reported that there are at least three published studies wherein S. bouardi has shown the ability to reduce antibiotic associated diarrhea. Certain researchers observed that a number of bacterial probiotics were used for treating antibiotic associated diarrhea and to a certain extent; the treatment was not successful (Marchand and Vandenplas, 2000). It could be inferred that certain probiotic cultures have the greater ability to treat one disease compared to others present in the probiotic product. Reports clearly reveal that one out of every four individual experiences antibiotic associated diarrhea (Doron et al. 2008). In this context, scientists at Indiana University School of Medicine investigated whether probiotics in yogurt prevent this ailment. A study was conducted with 202 subjects being hospitalized and receiving oral or intravenous antibiotics. Subjects were randomly selected for 8 ounces of yogurt and with no yogurt for a period of eight days. During this time period, frequency of diarrhea was assessed. Results showed 24% reduction in the occurrence of diarrhea in yogurt fed group as against control (no yogurt fed) group wherein only 12% reduction was observed (Beniwal et al. 2003).

d) Prevent urinary tract infections: In immune compromised as well as those with antibiotic treated hosts, the natural protective biofilm of bacteria and surface walls is lost through disruption. For a normal bacterial flora, host defense is ensured through a balance between non pathogenic commensals and pathogenic bacteria. In case of HIV+ patients colonization of lactobacillus in urogenital tract is diminished and this correlates with the shedding of HIV into the urogenital tract (Sha et al. 2005). Besides this, disruption of normal flora renders patients with many more severe infections.

In one of the study, wherein Reid and coworkers reported the use of probiotics for restoring host supportive bacterial flora (Reid et al. 2004). There are two main scientific concepts associated with probiotics, a) competitive theory, wherein live microbes administered orally or applied onto genital area overgrow the pathogenic flora and thereby restores the environment resistant to infections. In this case, the live microbe produces certain metabolites which are bactericidal or bacteriostatic to pathogenic flora in same host (Antonio and Hillier 2003). b) Second theory is based on the modulation of the immune system wherein live cells influences the production of immunoglobulins and thus altering the body's immune defense. They also contribute certain specific immune response against pathogenic bacteria (Humen et al. 2005).

In one of the case study, twelve subjects with neurogenic bladders had E. coli HU2117 coated catheters inserted for 28 days. The urinary tract infection reduced to 0.15 cases per 100 patient-days compared to 2.72 cases per 100 patient-days (Trautner et al. 2007).

e) Prevent anemia: Balamurugan and coworkers (2010) reported that anemic women had lesser number of Lactobacillus as compared to normal women. The main reason for this could be that lactobacilli increase the expression of iron transporters in the caecum due to production of propionic acid, a short chain fatty acid (Balamurugan et al. 2010).

f) Prevent type-2 diabetes: Musso and coworkers reported that the intestinal microbiota in type 2 diabetic patients have significantly reduced proportions of phylum Firmicutes and class Clostridia in the diabetic group compared to the control group (Musso et al. 2010).

g) Obesity associated problems: Number of studies has demonstrated that probiotics present in yogurt has obesity fighting potential. Johnson and coworkers while working with mice studied the anti obesity effects of probiotic yogurt and observed that mice fed on moderate fat diet was when supplemented with yogurt powder had significant weight loss compared to control (no yogurt fed). The weight loss was attributed to an increased lipid levels in feces of yogurt supplemented group thereby suggest that yogurt helps in
reducing fat absorption in small intestine (Johnson et al. 2007).

Similar study was conducted with human's at University of Tennessee in order to determine that yogurt consumption causes weight loss. In their study, randomly 34 obese subjects were selected and 18 ounces of fat free yogurt was given for 12 weeks. At the end of the study, the yogurt group experienced an average weight loss of 14 pounds and could retain 31% more muscle mass with 83% loss of more abdominal fat which was reflected in a reduction of over 1.5 inches from waist. While, the control group lost 0.23 inches from abdominal region with a weight loss of 11 pounds. This study also reflects that loss of visceral fat is associated with a reduced risk for cardiovascular disease and type II diabetes (Hamdy et al. 2006). In a study, it was observed that a higher concentration of Faecalibacterium prausnitzii found in obese children is one of the reason for obesity (Balamurugan et al. 2010). While, an altered ratio of Firmicutes and Bacteroidetes could also be one of the reason (Eckburg et al. 2005).

b) Combating cancer: Certain evidences have shown that incorporation of yoghurt in diet could protect against several types of cancer such as colon, bladder and breast. Pala and coworkers conducted a study which consists of 45,000 men and women for a period of 12 years. Results showed that subject fed with yoghurt reduces colon cancer risk upto 35% (Pala et al. 2011).

While, a Swedish group of Larsson and coworkers conducted a study on 80,000 men and women for a period of 9 years wherein their findings have shown 38% reduction in bladder cancer in the group fed with yoghurt compared to the control group (Larsson et al. 2008). In one of the study, Veer and coworkers observed that intake of fermented dairy products reduces 37% chances of breast cancer (Veer et al. 1989).

i) Reduce cardiovascular diseases: There are certain literature reports which showed that yoghurt offers a powerful cardiovascular support. In one of the report, wherein more than 1000 women aged 70 or more were fed with probiotic yogurt had shown a higher levels of HDL cholesterol with a significantly lower carotid artery thickness compared to those individuals not fed with yoghurt (Ivey et al. 2011).

In another similar case study, researchers when fed the subject with 10.5 ounces of full fat yoghurt for a period of 21 weeks showed an increase in HDL cholesterol level (~12 mg/dL) without any change in LDL levels. The reports also suggested that an altered LDL-HDL cholesterol ratio by 23% was observed when fed with probiotic yoghurt (Kiesling et al. 2002).

j) Fight dental problems: The bacterial growth in mouth could lead to inflammation and damage to gums and bones that support the teeth. The condition is known as periodontal disease or gum disease. This is associated with stroke and heart disease (Pihlstrom et al. 2005).

Ingestion of probiotics in any form, like in foodstuffs (cheese, yoghurt, fermented milk, fruit juice, or chewing gum) or as a constituent of tablets and capsules, has been shown to afford a health promoting effect on oral tissues, such as reducing the incidence of dental caries, improved management of periodontitis, abridged halitosis and oral candidal infections (Darwaze 2011). In another study, Japanese researchers reported that a daily intake of atleast 2 ounces of yoghurt was linked with a decreased risk of developing deep probing depth by 60% and clinical attachment loss by 50%, both periodontal disease parameters (Shimazaki et al. 2008).

In a study conducted by Saraf and coworkers (2010), their group observed that there is still inadequate knowledge and
amongst the consumers. In direct marketing strategy, the and TVC's in order to raise the popularity of their products they adopted direct marketing strategies apart from print ads. At present, the sales of probiotic product, Yakult is higher as "Sponsored seminars related to targeted work Public relations, conferences, media pay per click ads, direct mails Social media, blogs, email, newsletters, web banners, using modern trade institutions like colleges, schools, office supermarkets. The brand has worked out on pricing strategy and sold 65 ml at a price of 10 Rs. in a pack of five. This is reasonable for the health conscious consumers and for those who are aware of the importance of functional foods like probiotics. Yakult India Microbiota and Probiotic Science Foundation convened a symposium on "Probiotics in Prevention of Life Style Disorders" on Dec'2012 which brought together an interdisciplinary group of health care professionals to spread the healthcare information/ health benefits of probiotics in treatment of diseases or any new scientific developments related to probiotics. While, Amul launched the probiotic variants of the popular products already present in the market to increase awareness but marketing initiative taken by manufacturers is inadequate which restrain the category to reach its full potential. In store promotions would bring greater focus on the category. The retail service outlets of these popular dairy brands are using modern trade institutions like colleges, schools, office canteens, airports, five star hotels, and independent kiosks, apart from traditional spaces such as malls, high streets, and popular markets, for tapping their target consumer group. In this context, last but not least, different probiotic manufacturers should come together and develop strategic relationships in order to synergize their strengths and thus overcome any individual company's weaknesses to fulfill the increasing demand for probiotics. Futuristic approach for probiotics in terms of Research and Development At present, the sales of probiotics is limited to metropolitan cities to some tier I cities; since in smaller cities electricity and cold storage/refrigeration is the critical problem. In order to combat these problems scientists have taken a lead in this direction to make the product reach to larger section of the society mainly in rural areas wherein 70% of the Indian population resides. In this segment, research and development is largely focused on improving the stability and usability of probiotics. Newer technologies such as microencapsulation have been addressed to enhance shelf life and usability of probiotics. Besides this, newer potential strains which could withstand high and low temperature, or frequent temperature fluctuations and could be used in high pressure applications have been screened and identified.

Future strategies for increasing probiotic market in India Since, probiotics contains billions of live cells so adequate number of cold chain and storage facilities at their retail outlet should be introduced, initiative in marketing skills, increasing awareness campaigns by the brands and price reduction in probiotic products should be undertaken. The marketing strategy should consist of 4Ps, i.e., product, price, place and promotion. The product should be fairly reliable what the label mentions, it should be cost effective so that the health benefits of the product could reach to large section of the society in different geographical regions. The retail and distribution outlets should be there in maximum cities for availability of the product so that the cost of the cold stored vehicles used for transportation could be reduced and compensated with the cost price of the product. The promotional strategies could be used through following means:

- Social media, blogs, email, newsletters, web banners, pay per click ads, direct mails
- Radio, television, billboards, print ads
- Public relations, conferences, media
- Sponsored seminars related to targeted work

At present, the sales of probiotic product, Yakult is higher as they adopted direct marketing strategies apart from print ads and TVC's in order to raise the popularity of their products amongst the consumers. In direct marketing strategy, the consumers can order the product through home delivery. In this manner, Yakult has a DM (Direct Marketing) team of ladies known as Yakult ladies who visits home and thereby educates the homemakers about the product and answers the doubts and queries raised by consumers. This ensures that the product is being bought regularly by the consumers. Besides this, Yakult is also available in supermarkets. The health benefits of the product could reach to large section of the society in different geographical regions. The marketing strategy should consist of 4Ps, i.e., product, price, place and promotion. The product should be fairly reliable what the label mentions, it should be cost effective so that the health benefits of the product could reach to large section of the society in different geographical regions. The retail and distribution outlets should be there in maximum cities for availability of the product so that the cost of the cold stored vehicles used for transportation could be reduced and compensated with the cost price of the product. The promotional strategies could be used through following means:

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According to the reports of Frost and Sullivan analyst, the growth of probiotic cultures fortified food in India is bright since; Asians believe that these products are indispensable in nature for proper health and wellness. In this respect, scientists need to develop customized probiotic strains for specific applications to promote growth.

Raja and Arunachalam (2011) reviewed that at present the major challenge in front of probiotic companies are lack of standardization and need for validating product claims, lack of awareness from the lower middle class population in urban areas and rural masses which hinders the expansion plans of the dairy companies, Marketing and distribution challenges exist in India which is very diverse and presents a topography which requires specific case studies and temperaments. Launching the products with Indian consumer interests in mind and forming a team of Indian sales experts by the companies will reduce this challenge in a very effective way.

Conclusions

The prospect for the Indian probiotic market is expanding at a rapid pace due to globalization and increase in health awareness amongst Indian population especially urban lower middle class and rural masses. Realizing this, the Indian dairy industry has undergone paradigm shifts from manufacturing traditional milk products towards more beneficial functional milk products such as probiotics, or yogurt. In this respect, the proactive support of the government along with the fundamental factors like uninterrupted supply of raw materials, qualified man power, congenial investment climate are paveing the way for the probiotic industry to make giant strides in Indian market. Consumers should understand that anything in excess is not always good though probiotic has shown a lot of potential in aiding number of illness and conditions. In the past few decades, lot of research has been carried out in this direction but no concrete conclusion could be drawn till date and have to still wait more as research is going on in this direction. Till then, consumers should understand the concept, “probiotic rather than medicine”. Besides this, in the existing situation, excellent growth opportunities are stored for both domestic as well as for foreign companies to venture their capital in the probiotic industry and to make a mark for the betterment of the society.

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