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Nutritional Benefits and Role of Probiotics in the Modulation of Human Health

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ABSTRACT

Manuscript aims to describe the nutritional benefits of probiotics and their role in human health benefits. Probiotics are live microorganisms which are considered as non-pathogenic flora and provide benefits to the health of human. Probiotics are mainly used to hold the bacteria balance in the intestine. Probiotic bacteria help to reduce the development of harmful bacteria which may cause disease. Recently, probiotics are used in the food supplements to increase their nutritional value which also plays a role in the management of disease caused due to harmful bacteria. It can also modulate the immune function of the body. Probiotics are the latest products that lead to contribute to future health through the prevention and reduction of disease risk. This manuscript describes the properties, function and advantages of probiotics. The manuscript focuses on the types of probiotics and their role in the management of a disease. It also describes the probiotics mode of action in the treatment of disease. The list of marketed products related to probiotics is also summarized. The probiotics which are known as good bacteria are used to increase the nutritional value of the food which helps to manage the health and in the treatment of diseases related to the gastrointestinal tract.

KEY WORDS: PROBIOTICS; NUTRITIONAL BENEFIT; LACTOBACILLUS; BIFIDOBACTERIA; EUKARYOTIC; INFLAMMATORY BOWEL SYNDROME; H. PYLORI.

INTRODUCTION

The Probiotic word generally comes from the Greek words pro and bios which means 'for life'. In 1965, probiotics were first introduced by Stillwell and Lilly. Probiotics are the living microorganisms and microbial feed supplements. A probiotic is a live microbial feed that enhances the intestinal health of the host animal. The word probiotics are often referred as the microbial direct-fed. The terms microbial direct-fed and probiotics are used exchangeably. (Markowiak and Slizewska, 2018).

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Probiotics act as additives to feed which contains microbial species and known as normal non-pathogenic flora. The probiotics benefit health by improving the bacterial balance in the intestines when it is taken orally. Probiotics consist mainly bacteria, but they also include other types of organisms like yeast (Markowiak and Slizewska, 2018). Probiotics are identical or same as the "healthy bacteria" already exist in the body, mainly in guts. The intestinal tract of a normal human encloses 300-1,000 various species of bacteria. The digestive tract of a normal human contains approximately 400 types of probiotic bacteria which decrease the harmful bacteria growth and indorse a healthy digestive system (Markowiak and Slizewska, 2018;1 and Kerry et al., 2018,2).

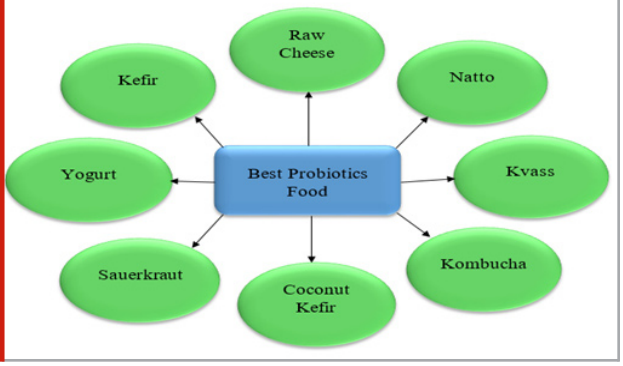
Probiotics can avoid or decrease the risk of disease that is also preferable for the treatment of the disease. Probiotics are developed as the main nutritional factor affecting the physiology and function of the gastrointestinal system. Intestinal microflora uses the probiotic microorganisms to improve well being (Markowiak and Slizewska,; 2018, Oak ,and Jha, 2019).

There is sufficient clinical evidence exists for the use of specific probiotics which help in the prevention and treatment of a few types of diarrhoea. Probiotics are also used to create new nutritional products. There is also scientific evidence that exists for specific forms of probiotic benefits in alleviating the symptoms of lactose intolerance, controlling the movements of the intestines and decreasing harmful enzyme activities in the intestine. The modification and binding of mycotoxin in the uncultivable portion of the human intestinal microflora help to prevent and treat food allergy (Oak and Jha 2019; Fenster et al., 2019).

Probiotics are the compound that is mainly isolated from the intestinal tracts of humans and animals. The products derived from end products of bacte¬rial growth or dead bacteria may also provide some advantages, but these derivatives are not used as probiotics because during administration they are not alive. The bacteria when not isolated, purified and proved for benefit of health after administration are called native bacteria (Cassani, Gomez-Zavaglia, Simal-Gandara, 2020). Probiotics are used in nutritional supplements and food like tablets, capsules, powders and other forms. Other sources of probiotics foods include yogurt, fermented and unfermented milk, juice, miso, soy beverages. Probiotics are similar to those bacteria which found naturally in humans guts, particularly in breastfed infants. The probiotics other than bacteria is yeast such as *Saccharomyces boulardii* (Focco et al., 2020). The best probiotics food are enlisted in figure 1.

Some Good Bacteria Examples: *Lactobacillus* (abbreviated L.) *acidophilus* (produces natural antibodies), *L. reuteri* (may protect against food poisoning caused due to *Salmonella* and *E. coli*), *L. salivarius, L. casei, L. plantarum, L. rhamnosus, L. paracasei, L. brevis, L. intantis* and *Lactobacillus* GG; *Bifidobacterium* (*abbreviated* B.) *bifidum, B. lactis, B. longum, Enterococcus faecium, Streptococcus thermophilus, Saccharomyces boulardii* (Santo et al., 2020)[7]. This manuscript describes the properties, function and advantages of probiotics. The manuscript describes the role of probiotics and their role in the health management. It also summarizes the list of products related to probiotics selled in market (Santo et al., 2020).

Figure 1: Schmeatic diagram to show best probiotics



Function Of Probiotics: Probiotics help in diarrhoea treatment. It can treat and prevent infections of the urinary tract and the genital organ of females. Probiotics treat the disease of irritable bowel syndrome and decrease the chance of bladder cancer (Parvez et al., 2006). Long intestinal infection and atopic dermatitis may be treated with probiotics. Probiotics can play a major role in the treatment of lactose intolerance and to maintain cholesterol levels (Kerry et al., 2018).

Advantage of Probiotics: Probiotics are dietary supplements or food products that contain beneficial elements to the host body. It maintains the optimal health and wellness of human beings. It can provide a natural defense or immune system to the body. Probiotics can prevent the growth of harmful bacteria. Probiotics make the immune system to fight against allergies and other autoimmune diseases. It helps the body to produce vitamins and support healthy digestion (Verschuere et al., 2000). Probiotic increase defecation and reduce constipation. It can control the illness-caused by bacteria present in the intestinal tract. It reduces the effects of Candida infection.

Probiotics improve the digestion of lactose, especially for the lactose-intolerant individual. It reduces cholesterol levels and blood pressure. It improves the absorption of minerals, especially calcium from the body (Verschuere et al., 2000). It decreases the dental-caries caused by microbes present in the mouth. Probiotics used to cure vaginal yeast infections and in urinary tract infections treatment. It manages the signs and symptoms of irritable bowel syndrome. Reduces the amount of cancer causing substances in the intestine. Reduce the development of allergy in children and also reduces the infections and inflammation (Kerry et al., 2018, Verschuere et al., 2000; Kerry et al., 2018).

Probiotics provide bile acid tolerance which is difficult to maintain during oral administration. Adherence to epithelial and mucosal surfaces is a crucial factor for successful immune modulation, competitive exclusion of pathogens and pathogen adherence and colonization prevention. It has antimicrobial activity against pathogenic bacteria and also act as bile salt hydrolase (Ziemer and Gibson,1998; Kerry et al., 2018).

Types of Probiotics: Different types of probiotics are described below:

1. Lactobacillus: *Lactobacilli* have more than 50 species. They are found naturally in the urinary, genital and digestive systems. Fermented food like yogurt is used as dietary supplements. *Lactobacillus* has been used to treat and prevent a wide variety of diseases and conditions. Different *Lactobacilli* species are found in foods supplements such as *Lactobacillus acidophilus*, *Lactobacillus bulgaricus*, *L.acidophilus* DDS-1, *Lactobacillus* rhamnosus GG, *Lactobacillus reuteri*, *Lactobacillus salivarius, Lactobacillus plantarium, Lactobacillus johnsonii, Lactobacillus casei* etc. *Lactobacillus* can prevent and treat bacterial vaginosis, yeast infections, urinary tract infection, antibiotic-related diarrhoea, irritable bowel syndrome, travelers diarrhoea, diarrhoea resulted from Clostridium difficile, skin disorders, treating lactose intolerance and respiratory infections prevention (Ziemer and Gibson, 1998; Amara and Shibl, 2015).

2. Bifidobacteria: *Bifidobacteria* have more than 25 species. They are used to make up healthy bacteria in the colon. It exists in the intestinal tract of breastfed infants from the day of birth. *Bifidobacteria* species are used as probiotics such as *Bifidobacterium bifidum*, *Bifidobacterium longum, Bifidobacterium lactis*, *Bifidobacterium breve*, *Bifidobacterium thermophilum, Bifidobacterium infants* and *Bifidobacterium pseudolongum. Bifidobacteria* help to increase glucose tolerance and blood lipids levels. *Bifidobacteria* improve symptoms of the IBS such as pain, discomfort, bloating distension, disorders of digestion (Amara and Shibl, 2015).

3. Saccharomyces boulardii: This bacteria is the only yeast probiotic called as *S. boulardii*. It may prevent and treat traveler's diarrhoea and diarrhoea associated with the use of antibiotics. It has been also used to prevent *C. difficile* reoccurrence which helps to treat acne and reduce side effects of H. pylori treatment (Kerry et al., 2018,; Amara and Shibl, 2015.

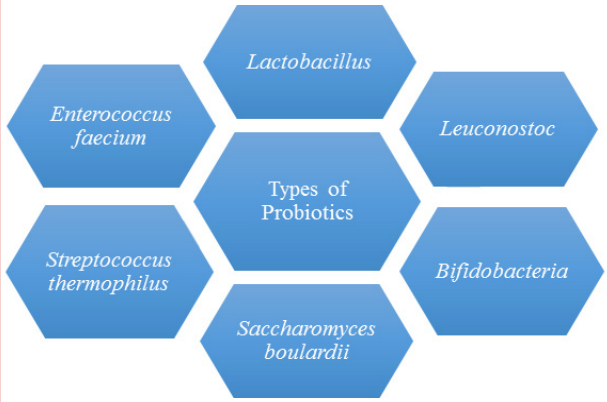
4. Streptococcus thermophilus: It produces a large amount of the lactase enzyme and helps to prevent the intolerance of lactose.

5. Enterococcus faecium: It is commonly present in both the human and animal intestinal tract.

6. Leuconostoc: It is used in food processing from a very earlier time. The foods containing metabolites of microorganisms, live bacteria and dead bacteria are ingested from a long time (Amara and Shibl, 2015).

Different types of probiotics are shown in figure 2.

Figure 2: Schematic diagram of different types of probiotics



Probiotics In Helicobacter pylori Infections: *H. Pylori* induces multiple gastrointestinal diseases like chronic gastritis and peptic ulcer. The latest treatment choices are antibiotics and proton pump inhibitors. Probiotics have been used to supplement infection control by using different *Lactobacillus* species which is demonstrated in both in vitro and in vivo studies. From in vitro studies, it was suggested that direct antimicrobial activity of *Lactobacillus* species occurs by competition with *H. pylori*, thereby demonstrating the clinical progress in patients treated with probiotics (Markowiak and Slizewska, 2018).

However, the results are positive, yet probiotics can not be proposed as a valid substitute for *H. Pylori* infections standard treatment. *Helicobacter pylori* is a bacterium in small curved to spiral rod shape. It is strongly associated with duodenal peptic ulceration and used as the main etiologic agent for chronic gastritis, gastric cancer and other gastric malignancies (Tripathi and Giri, 2014). Today, the therapy based on a combination of antibiotics and proton pump inhibitors are used to kill this bacterium. Probiotics tend to have a direct antimicrobial effect which was demonstrated through in vitro studies, competing with *H. pylori*, adherence inhibition, metabolites production and antimicrobial molecules. (Markowiak and Slizewska, 2018, Tripathi and Giri, 2014).

In a study, 60 participants were treated with triple antibiotic therapy on days 1-7 and *Lactobacillus* GG on days 1-14 in a double blind, randomized, placebo-controlled trial. Probiotics considerably improved the symptoms of taste disturbance, nausea and diarrhoea. However, epigastric pain during eradication treatment did not significantly improve. The eradication rates between the groups did not differ significantly (83.3% vs 80%) (Tripathi and Giri, 2014; Markowiak and Slizewska, 2018).

In another placebo-controlled, randomized, double blind trial the asymptomatic 85 patients of *H. pylori* were randomized to receive treatment from days 1-7 with placebo from days 1-14. Probiotics show significantly improved symptoms during treatment of diarrhoea and taste disturbance; but epigastric pain and nausea did not improve significantly during *H. pylori* treatment (Granato et al. 2010). During the study all the differences between the probiotics and placebo were noted. None of the probiotics has been better than another. Eradication rates among the 4 groups that received probiotics were not significantly different. A randomized double-blind placebo-control study was conducted on 47 patients using a milk based fruit drink containing *Propioni bacterium*, *Lactobacillus* GG, *Bifidobacterium*, or placebo from day 1-28 and triple antibiotic therapy from days 1-7 (Granato et al., 2010).

Probiotics did not improve symptoms significantly, including taste disturbance, nausea, epigastric pain and diarrhoea (Ziemer and Gibson, 1998,; Granato et al., 2010). Recently a meta-analysis showed that supplementation with *S. boulardii* significantly raised the eradication rate and reduced the overall risk for *H. pylori* related adverse reactions, particularly in diarrheoa. However, the products used in such trials are not usually marketed in the US, making it difficult to support evidence related to probiotic. Although a specific strain of *Lactobacillus* supported by the US may not be available in the market, because it may not be fair to extrapolate the results of strain to other types of *Lactobacillus* so the product selections are limited (Butel, 2014).

Probiotics In Irritable Bowel Disease: Gastrointestinal problem includes irritable bowel syndrome (IBS), abdominal pain and excessive flatulence. Motility disorders and psychological mechanisms have been suggested to differentiate the intestinal microflora in people with IBS and with healthy peoples. In comparison with healthy people, these patients have low numbers of *Llactobacilli, Bbifidobacteria* and higher numbers of facultative microbes. Probiotics are used as therapy but the results are unclear. A preventive strategy may have more benefit for *Llacto bacillus* than when it is used in the IBS treatment, although this has not been confirmed. (Amara and Shibl, 2015).

The role of intestinal bacteria in the IBS pathogenesis has been suggested by physiological, epidemiological and clinical trials. Some earlier studies indicate that gastroenteritis is the main cause of IBS (Butel, 2014)[14]. A cohort study in Canada, an epidemic of gastroenteritis showed an increased IBS patient in 2 years, which lasted for 8 years. In another study, the incidence of gastroenteritis was associated with approximately a four-fold rise in the probability of developing IBS in the previous 2 years. Physiological research on animals and humans demonstrated a profound impact of alterations in the intestinal microbiota composition of the normal and IBS patients intestine (Amara and Shibl, 2015). The developing IBS increases the risk of dysbiosis, gastroenteritis and increases the production of luminous gas and immune activation suggests that the gastrointestinal microbiota may be a therapeutic target for IBS (Butel, 2014; Amara and Shibl, 2015, Butel, 2014).

While numerous probiotics efficacy Randomized Clinical Trials have been assessed with IBS patients, they often suffer from severe methodological flaws. Brenner and colleagues reported in a recent systematic review that 16 RCTs were assessed as effective probiotics in the treatment of IBS, *Bifidobacterium infants* 35624 was the only probiotic that offered substantial improvements in IBS symptoms. VSL#3 has demonstrated a greater improvement in abdominal pain and bloating symptoms globally. A randomized cross-over trials was done with 59 children having IBS. Some meta-analysis indicates that probiotics have a more beneficial effect on abdominal pain and flatulence. *Bifidio bacterium* is available on the market in combination with Align capsules or other probiotic organisms as OWP probiotic capsules, and VSL#3 packets for the treatment of IBS. More evidence is needed before IBS is used as probiotics for control symptoms (Rivera-Espinoza and Gallardo-Navarro, 2010).

Probiotics and Bacterial Translocations: Many studies have been shown that patients who are unable to feed enternally after severe gastrointestinal surgery or liver transplantation also have a high risk of septicemia from the intestinal tract triggered by bacterial organisms. A study describes various ways in which probiotics can decrease bacterial translocation. It seems possible to eliminate postoperative infections by altering the luminal bacterial milieu. The research results are promising but need confirmation in larger prospective studies. In mesenteric lymph nodes (MLN), the detection of viable bacteria represents bacterial translocation in the intestine lumen. (Millette et al., 2013). Each rats lymph nodes were aseptically removed from the ileocaecal and left colonic regions and dissected (Millette et al., 2013).

Nodes were then homogenized for the cultivation of aerobic and anaerobic bacteria in 1 ml of sterile phosphate buffer saline or thioglycollate broth respectively. At 37°C, a 0.1 ml aliquot of each homogeneous was placed on blood agar and incubated and the number of colonies was counted on all plates. Bacterial translocation data are defined as medians and ranges of the total colony forming unit (CFU) (both aerobic and anaerobic) will be calculated from the cultured plate after 48 hours of incubation from MLN of each rat (Cousin et al., 2012; Millette et al., 2013, Cousin et al., 2012).

Probiotics and Safety: Over the last few decades the use of probiotics has increased, especially in dairy products. The studies focus on infection risk, toxicity, deleterious metabolic activity and antibiotic resistance with increasing probiotic strain in dairy products (Ozyurt and Otles, 2014). In safety assessment, children and infants are especially found to be vulnerable at a period when the intestinal environment and the immune system are under development. However numerous studies have

not shown any adverse results even on preterm infants. It seems like most people do not suffer from probiotics side effects or have just mild gastrointestinal side effects including gas. But there have been several case reports of serious adverse effects (Kent and Doherty, 2014).

A review on probiotics safety suggested that *Lactobacillus rhamnosus* GG was widely studied for a variety of conditions in clinical trials and found to be generally safe. Nevertheless, a recent review of *Lactobacillus* and *Bifidobacterium* noted the long-term, cumulative effects of probiotics use, especially in children and also indicates the evidence that probiotics should not be used in patients with a critical illness (Saxelin et al., 2010). Similarly, a 2011 Agency for Healthcare Research and Quality Assessment on the safety of the probiotic, partly funded by National Center for Complementary Alternative Medicine (NCCAM), concluded that the current evidence does not suggest a widespread risk for probiotic related side effects. However, safety data, especially long-term protection are limited and the risk of serious side effects in people may be greater with underlying health conditions (Garanto et al., 2010; Saxelin et al., 2010;19,20 Kent and Doherty, 2014).

Eukaryotic Probiotics: Eukaryotic microorganisms are very useful as probiotics for animal health. There are several eukaryotes grade of food/feed, like as algae (e.g. Spirulina, Chlorella species), fungi (e.g. Penicillium, Aspergillus species), yeasts (e.g. Candida, Saccharomyces, Pichia, Kluyveromyces, Torulopsis species), which are being consumed by human and animals throughout the world since a very long time. These organisms are mostly used as single cell protein and as food starters components. However, certain eukaryotes are found to be executing probiotics like beneficial effects in the host when supplemented in living conditions through diet (Hennequin et al., 2000) (Hirimuthugoda, Chi and Wu, 2007).

Therefore, the development of new candidate species beyond prokaryotic origin is believed to be a very crucial event in the field of probiotics. Significant interest in eukaryotic probiotics is growing nowadays and in most cases their efficacy and usefulness have been proven by strong scientific evidence. Most of the eukaryotic probiotics used in human and animal practices belong to the dominant group of fungi, yeasts and mould. Pichia, Candida, Saccharomyces, Yarrowia, Metschnikowia, Isaatchenkia, Debaryomyces, Aspergillus and Kluyveromyces are common examples of eukaryotic microorganisms with probiotic properties (Holubarova, Muller and Svoboda, 2000). From 1,550 BC, yeast has historically been used for fermentation purposes. Nowadays, yeasts are a part of dietary supplements and healthy food realms because of their proven beneficial probiotic effects. Saccharomyces genus of yeast has commonly used probiotics in humans and animals worldwide (Hottiger, Boller and Wiemken, 1987; Holubarova, Muller and Svoboda, 2000).

Mode of Action of Probiotics: Several studies have demonstrated several types of probiotic action in the aquatic environment. Selected strains were determined to produce digestive enzymes, thus facilitating the utilization and digestion of the feed. The enzymatic properties of intestinal anaerobic bacteria isolated from three species of fish, showing the potential role as a probiotic. In the research, the addition of the two intestinal fish Bacillus spp. was done. Increased performance as assessed by several factors including growth, feed conversion and protein efficiency ratio (Gomez-Gil, Rogue and Velasco-Blanco, 2002). The bacteria attributed the result to the production of the extracellular cellulolytic and amylolytic enzymes. While competition has been widely suggested as a mode of action for adhesion sites, there is little evidence in the literature to prove this fact. Studies report adhesion of certain bacteria to in vitro intestinal mucus and the attachment ability of potential probiotics seen *in vitro* can not be assumed to demonstrate the real *in vivo* effect (Gomez-Gil, Rogue and Velasco-Blanco, 2002).

Additionally, studies have shown the ability of some bacteria to adhere with in vitro intestinal mucus they have failed to assess a competitive exclusion effect. More recently, it has been shown that five probiotics versus two pathogens on fish intestinal mucus exhibited a competitive exclusion effect. The presence of one of the probiotics on the mucus was found to inhibit the attachment of one of the tested pathogens. Interestingly, pre-colonization with the other probiotics prompted the two pathogens to attach themselves. However, the general trend of their research has shown that the pathogen was displaced after treatment with probiotics (Holubarova, Muller and Svoboda, 2000,; Gomez-Gil, Rogue and Velasco-Blanco, 2002).

Although not directly related to attachment competition, it was shown that two seaweed-associated Bacillus spp. produced antibiotic substances. It was dependent on bacteria forming biofilms. This study highlighted a factor i.e. surface attachment, that could be essential for some bacteria to be successful probiotics. This observation concurred with the definition of a probiotic, i.e. the colonization requirement for GIT. (Rogue and Velasco-Blanco, 2002).

It was suggested that the competitive exclusion mechanism for attachment sites could be given a distinct advantage through the addition of probiotic bacteria during the larviculture initial egg fertilization steps, thus "getting in there first". This concept was not supported because when these bacteria were administered at hatching and two days after hatching, no difference was observed between the concentrations of two bacteria in the gut of turbot larvae. Several studies have attributed a probiotic effect to an energy source competition. Artemia sp. was found beneficial for growth and survival.

It was pre-exposed to nine bacterial strain before challenging with *V. proteolytic*. It was concluded that the extracellular products do not cause any effect, but the live bacterial cell was required. Although not

specifically tested, they hypothesized that the protective effect was probably the result of competition for energy sources and sites of adhesion. Competition for iron has been reported as an important factor in marine bacteria. Iron is required for the growth of most of the bacteria but is generally limited in the animal tissues and body fluids and the insoluble ferric Fe^{3+} type iron-binding agents, siderophores, enable iron acquisition suitable for microbial growth (Gram et al., 1999).

Siderophore production is a noted mechanism of virulence in some pathogens equally, a siderophore producing probiotic could deprive potential pathogens of iron under iron limiting conditions. This was shown by a supernatant culture of Pseudomonas fluoresces, grown under limited conditions of iron, inhibited *V. anguillarum* growth, while the supernatant from iron-available cultures did not inhibit the growth (Gram et al., 2001). It was found that the addition of *Bifidobacterium thermophilum* derived peptidoglycan increased significantly their survival when they were challenged with V. penaeicida. It was attributed that an immune stimulatory effect, as the phagocytic activity of shrimp granulocytes was significantly higher in the treated shrimp compared with those of the control animals. Research differentiated slightly to approach towards immune-stimulating probiotic (Gullian, Thompson and Rodriguez, 2004).

Instead of analysing bacterial derivatives such as glycans or lipopolysaccharides, they tested live *Vibrio* sp. (P62) for immune stimulation and Bacillus sp. (P64) and *V. alginolyticus* used as a positive control. They concluded the immune stimulants activity of P64 and *V. alginolyticus* (Gram et al., 2001; Gullian, Thompson and Rodriguez, 2004).

Probiotic Products: The most popular approach to consume probiotic cells are through food products. The global market for functional foods and beverages has grown from $33 billion in 2000 to $176.7 billion in 2013, representing 5% of the food market as a whole. Probiotic foods are comprised between 60%-70% of the total functional food market. Probiotic microorganisms are typically available as dried or deep-freeze culture concentrates to be added to a food matrix. Lactic acid bacteria of the genera *Lactobacillus* and *Bifidobacterium*, are the most common genera and species, as they are widely recognized as safe (Hagi et al., 2004,; Granato et al., 2020).

The species *Lactobacillus* and *Bifidobacterium* are also predominate in the human intestine (*Bifidobacterium* in the large intestine and Lactobacillus in the small intestine). However, bacterial species of the genera *Lactococcus, Enterococcus* and *Propionibacterium*, yeasts (e.g. *Saccharomyces boulardii* and *Saccharomyces cerevisiae*) and filamentous fungi (e.g. *Aspergillus oryzae*) are also used as probiotics due to their beneficial effects on health (Satkori, 2019,; Min. et al[31,32]., 2019).

Also, some people suggest that multispecies supplementation of dairy probiotic products may have a more specifically targeted function in the human food tract. Maintaining the viability of probiotic cells during food-processing and gastro-intestinal transit is important for microorganisms to reach adequately the intended site of action (108 cells/gram). (Tarkhani et al., 2020, Barbosa et al., 2011). Due to passage through the low pH environment of the stomach and high bile salt conditions in the intestine, there is a significant loss of viable cells following the ingestion of a probiotic (Barbosa et al., 2011; Tarkhani et al., 2020).

One possible solution for this problem is microencapsulation. *Encapsulation* is a mechanical or physicochemical process that traps a material that is potentially sensitive and provides a protective barrier between it and the external conditions. The spray-drying, emulsion and extrusion techniques are well known methods of encapsulation for the processing of probiotics microcapsules (Taskin, 2020). The probiotic effect and survival are strain dependent, therefore it must be perfectly identified and characterized (phenotypic and genotypic identification). *Lactobacilli* are generally stronger than Bifidobacteria, in terms of robustness of probiotic species, more resistant to low pH and have a greater tolerance to milk and other food substrates. Probiotic products can be classified as dairy probiotic products and non-dairy probiotic products depending on the matrix that carries the probiotic bacteria. Dairy beverages are produced from milk or its derivatives, with or without the addition of other ingredients in which the milk base represents at least 51% v/v of the formulation and can be fermented using yogurt cultures (Taskin, 2020, Guimaraes et al., 2019; Taskin, 2020).

Fermented milks, ice cream, different kinds of cheese, milk powder and baby food, whey-based beverages, frozen dairy desserts, buttermilk, sour cream, normal and flavored liquid milk are the most common dairy probiotic products. Milk and dairy products are abundant minerals sources which play a variety of roles in the human body. However, becuae of the high content of saturated fatty acids the availability of minerals from cheeses and cheese-like products is lower than that from other dairy products (Saxelin et al., 2010). Alejewicz and Cichosz have determined the effect of the probiotic culture of *Lactobacillus rhamnosus* HN001 on the increase of magnesium, calcium, phosphorus, zinc and potassium in cheese. The addition of *Lactobacillus rhamnosus* HN001 increases the availability of divalent metal cations. Also, other technologies and methodologies can be applied to existing probiotic dairy products (Taskin, 2020).

Kent and Doherty (2014) used an isotherm differential scanning calorimetry method to identify the probiotic microbes in probiotic products (Kent and Doherty, 2014). The products were developed and now commercial in Hungry. Products are Probiotic kefir (Symbiofir), probiotic sour cream, probiotic butter cream, poultry meat products supplemented with calcium and bakery products complement with calcium. Demonstrated that

the optimal concentration of constituents such as whey in probiotic dairy beverages could be calculated by using mathematical models such as survival analysis, minimal significant difference and mean global acceptability. Because of the high prevalence of lactose intolerance, different non-dairy probiotic products such as vegetarian-based products, fruit juices, cereal-based products, oat-based desserts, soya-based products, breakfast cereals, confectionery products and baby foods have been developed in recent years (Saxelin et al., 2010;, Gonzalez-Sanchez, 2010; Kent and Doherty, 2014).

Technological developments have made it possible to alter certain structural characteristics of fruit and vegetable matrices by modification of food components in a controlled way. It could make them perfect substrates for the probiotics culture. Cereal grains are one of the most essential sources of carbohydrates, protein, vitamins, fiber and minerals; Lactobacillus strains are fastidious microorganisms that require these sources for growth. Moreover, cereals can serve as prebiotics because they can be used as sources of non-digestible carbohydrates, encouraging the growth of the colon's *Lactobacilli* and *Bifidobacteria* (Matias et al., 2014). Another good raw material to be used as an alternative for the nondairy probiotic carrier is soy, which has some sugars and amino acids in its composition that are used as substrates by lactic acid bacteria to produce aroma compounds. However, soy intake is limited due to its undesirable beany flavor and the presence of oligosaccharides frequently contributing to flatulence and discomfort in the stomach (Matias et al., 2014).

One way to improve the sensory consistency of soymilk and also to mask undesirable compounds is by fermenting the lactic acid which can be combined with supplemental glucose, sucrose and lactose. Bakery products like bread are stapled foods composed of many main components (complex carbohydrates, insoluble dietary fiber, lipids, proteins, vitamins and minerals) in varying amounts and with varying physical interactions and structures. Cespedes et al. (2013) Soukoulis et al. developed probiotic bread with addition of the bacteria *Lactobacillus rhamnosus* GG, using air dried probiotic edible films. Meat can be also provide another source of probiotic products. The buffering capacity of meat may be attributable to an elevated pH of the microenvironment for the living of bacteria on its surface. It is important to continue the research into new non-dairy probiotic products that could have a wide market because of the high prevalence of lactose intolerance and vegetarianism (Cespedes et al., 2013).

CONCLUSION

It can be concluded from the literature survey that probiotics play a vital role in the management of the health of human beings. Proper concentration and species of probiotics are necessary for the maintenance of the immunity of the organism. Probiotics are used in the food supplements which increase the nutritional value of the food which is beneficial for human health. Probiotic microorganisms are available as culture concentrates in dried or deep-freeze form which is added to a food matrix and marketed as a food product. The main products of probiotics developed in recent years are vegetarian-based, cereal-based products, fruit juices, soya-based products, oat-based desserts, confectionery products, breakfast cereals and baby foods. The probiotics are mainly used to maintain the level of good bacteria inside the gastrointestinal tract mainly in the intestine. It helps to decrease the chances of disease related to the gastrointestinal tract. It also proves their activity in the treatment of the various diseases related to humans. The manuscript describes the function, advantages, mode of action and marketed products of probiotics and their role in human health management.

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