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RESEARCH ARTICLE

HEALTH BENEFITS OF PROBIOTICS

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Abstract:

Probiotics are living bacteria that, when administered in adequate amounts, confer a health benefit on the host. The discovery of the benefits of probiotics began with sour milk. Today we have many other options to get various bacteria from our foods, although it's not as simple as just adding them to the food. Probiotics may seem new to the food and supplement industry, but they have been with us from our first breath. During a delivery through the birth canal, a newborn picks up the bacteria Bacteroides, Bifidobacterium, Lactobacillus, and Escherichia coli from the mother. These good bacteria are not transmitted when a Cesarean section is performed and have been shown to be the reason why some infants born by C-section have allergies, less than optimal immune systems, and lower levels of gut microflora.Probiotics are believed to protect us in two ways. The first is the role that they play in our digestive tract. We know that our digestive tract needs a healthy balance between the good and bad bacteria, and it looks like our lifestyle is both the problem and the solution.. Probiotics have also been researched for how they support the immune system. Studies suggest that probiotics can improve how the immune system functions such as by decreasing upper respiratory tract infections in adults and reducing the need for antibiotics. Studies in children show that a regular diet including probiotics reduces colds and flu-like symptoms and improves attendance in preschool and day care settings.

Key Words: Probiotics,Health Benefits of Probiotics,Side Effects of Probiotics.

Introduction

The term probiotic (opposite of antibiotics) is relatively new and is currently used when we refer to bacteria associated with beneficial effects on humans and animals. It was invented in the early twentieth century by Nobel Prize winner, Eli Metchnikoff, and introduced in his study the prolongation of Life. Optimistic Studies proposing the interesting idea that microorganism may have beneficial effects on human health and especially on digestive disorders (Metchnikoff, 1907). Metchnikoff has shown since 1907 that Lactobacillus bulgaricus is able to eliminate pathogenic bacteria from the intestinal micro flora.

The actual introduction of the concept belongs to Lilly and Stillwell in 1965, after which probiotics are characterized as "microorganisms that promote growth of other microorganisms (Lilly *et al*., 1965).

In 1974, Parker talks about a food supplement for livestock and improve name of probiotics as "organisms and substances that helps the microbial ecosystem (Parker, 1974). Their importance was highlighted by Fuller in 1989 who described probiotics as live microorganisms with beneficial effects on host body, improving intestinal microbial balance (Fuller, 1989). Today the universal meaning of the term "probiotic" was established by the World Health Organization and the Food and Agriculture Organization of the United States. These two organizations defined probiotics as "live microorganisms which when administered in adequate amounts, have a beneficial effect on health of the host organism"

DEFINITION

Probiotics are living bacteria that, when administered in adequate amounts, confer a health benefit on the host (FAO/ WHO 2001).

Probiotics commonly are isolated from human and animal intestinal tracts. Dead bacteria, products derived from bacteria, or end products of bacterial growth also may impart certain benefits, but these derivatives are not considered to be probiotics because they are not alive when administered. Native bacteria are not probiotics until the bacteria are isolated, purified, and proved to have a health benefit when administered.

The original observation of the beneficial properties conferred by some bacteria is attributed to the Nobel Prize winner Eli Metchnikoff, who is regarded as the grandfather of modern probiotics. In the early 20th century, Metchnikoff discovered that "healthy bacteria," especially lactic acid bacteria (LAB), can have a positive influence on digestion and the immune system (Anukam and Reid ,2008). Most microorganisms recognized to date as probiotics are Gram-positive, with Lactobacillus and Bifidobacterium being the main species used as treatments of intestinal dysfunctions (Marco *et al*., 2006). However, some Gram-negatives are also used as probiotics. The best example of this group is Escherichia coli Nissle 1917 (EcN) (Nissle,1959), also known as "Mutaflor," which has been used in Germany for many years in the treatment of chronic constipation (Mollenbrink and Bruckschen, 1994) and colitis (Schutz, 1989). The vast majority (> 90%) of the total cells in the body are present as bacteria in the colon, reaching 1012 for every gram of large intestinal contents. Under natural conditions, a protective gut micro flora develops and there is no need for a bacterial supplement. But the changing food habits and lifestyle force us to take processed and sterile food, which affects our access to, and colonization, by certain type of bacteria.

Moreover, we also consume antibacterial substances ranging from vinegar to antibiotics. In the last century, many studies have reported probiotic bacteria to play important roles in the modulation of immunological, respiratory, and gastrointestinal functions (Floch et al., 2011).

Furthermore, probiotics have been shown to play a protective role by directly competing with intestinal pathogens through the release of antibacterial substances such as bacteriocins (Cotter *et al.*, 2005) or metabolites such as acetic acid and lactic acid (Servin, 2004). Although most studies on probiotics have been empirical, new advancements may originate from research on the interactions between commensal microorganisms (termed the microbiota), pathogens, and the host. Understanding the mechanisms of gut colonization in both normal and inflammatory conditions is essential to designing probiotics for a specific use.

Worldwide, a diverse array of probiotic products is on the market. Yogurt is perhaps the most common probiotic-carrying food, but the market has expanded beyond yogurt. Cheese, fermented and unfermented milks, juices, smoothies, cereal, nutrition bars, and infant/toddler formula all are food vehicles for probiotic delivery. In addition to being sold as foods, probiotics are sold as dietary supplements, medical foods, and drugs. Often these products are composed of concentrated, dried microbes packaged into capsules, tablets, or sachets. This format is convenient for the delivery of large numbers of microbes that, if manufactured and stored properly, can be quite stable even at room temperature (Judith, 2013).

CRITERIA FOR CLASSIFYING A MICROORGANISM AS A PROBIOTIC

1. It must be of human origin.
2. Have non- pathogenic properties.
3. Resistance to technological processes (i.e. viability in delivery vehicle).
4. Stability in acid and bile.
5. Adhesion to target epithelial tissue.
6. Ability to persist within the gastrointestinal tract.
7. Production of antimicrobial substances.
8. Ability to modulate the immune system.
9. Ability to influence metabolic activities. (Dunne *et al*., 2001).

RELATIONSHIP BETWEEN PROBIOTICS, PREBIOTICS AND SYNBIOTICS

Probiotics are live microorganisms which, when administered in adequate amounts, confer a health benefit on the host. They can be formulated into many different types of products, including foods, drugs, and dietary supplements.

Prebiotics are dietary substances that nurture a selected group of microorganisms living in the gut. They favor the growth of beneficial bacteria over that of harmful ones. Unlike probiotics, most prebiotics are used as food ingredients in biscuits, cereals, chocolate, and dairy products. Commonly known prebiotics are:Oligofructose, Inulin , Galacto-oligosaccharides ,Lactulose ,Breast milk oligosaccharides.

Synbiotics are appropriate combinations of prebiotics and probiotics. A synbiotic product exerts both a prebiotic and probiotic effect.

CHARACTERISTICS OF PROBIOTICS

Certain physiological characteristics may be important for probiotics targeted toward particular applications. For example, resistance to stomach acid and pancreatic secretions such as bile and digestive enzymes would be important for probiotics needs to survive in high numbers through the small intestine. But if the target site for the probiotic is, for example, the mouth, these traits would not be relevant. It is apparent from the broad range of potential probiotic targets that what is required of a probiotic depends on the specific target function. Yet some basic criteria for probiotics can be set: namely

1. They are nonpathogenic, nontoxic, and free of significant adverse side effects;
2. They must be shown to exert a beneficial effect on the consumer, preferably with a mechanistic explanation of how this occurred
3. They should retain stability during the intended shelf life of the product;
4. They should contain an adequate number of viable cells to confer the health benefit;
5. Should be compatible with product format to maintain desired sensory properties (Cast, 2007).

COMMON MICRO-ORGANISMS USED AS PROBIOTICS

Lactobacillus,
Bifidobacterium,
Saccharomyces,
Streptococcus,
Enterococcus,
Bacillus and
Escherichia coli (Nissle,1917)

There are several different kinds of probiotics, and their health benefits are determined by the job that they do in the gut. They must be identified by their genus, species, and strain level. (Senok *et al*., 2005)

Lactobacillus

There are more than 50 species of lactobacilli. They are naturally found in the digestive, urinary, and genital systems. Foods that are fermented, like yogurt, and dietary supplements also contain these bacteria. Lactobacillus has been used for treating and preventing a wide variety of diseases and conditions.

Some of the lactobacilli found in foods and supplements are Lactobacillus acidophilus, L. acidophilus DDS-1, Lactobacillus bulgaricus, Lactobacillus rhamnosus GG, Lactobacillus plantarium, Lactobacillus reuteri, Lactobacillus salivarius, Lactobacillus casei, Lactobacillus johnsonii, and Lactobacillus gasseri (Iyer *et al.*, 2008).

Bifidobacteria

There are approximately 30 species of bifidobacteria. They make up most of the healthy bacteria in the colon. They appear in the intestinal tract within days of birth, especially in breastfed infants and are thought to be the best marker of intestinal health.

Some of the bifidobacteria used as probiotics are Bifidobacterium bifidum, Bifidobacterium lactis, Bifidobacterium longum, Bifidobacterium breve, Bifidobacterium infantis, Bifidobacterium thermophilum, and Bifidobacterium pseudolongum (Fijan, 2014).

Saccharomyces boulardii

This is also known as S. boulardii and is the only yeast probiotic. Some studies have shown that it is effective in preventing and treating diarrhea associated with the use of antibiotics and traveler's diarrhea. It has also been reported to prevent the reoccurrence of C difficile, to treat acne, and to reduce side effects of treatment for H. pylori (Kabir, 2011).

Streptococcus thermophilus

This produces large quantities of the enzyme lactase, making it effective, according to some reports, in the prevention of lactose intolerance.

Enterococcus faecium

This is normally found in the intestinal tract of humans and animals.

Leuconostoc
This has been used extensively in food processing throughout human history, and ingestion of foods containing live bacteria, dead bacteria, and metabolites of these microorganisms has taken place for a long time (Fijan, 2014).

FOODS THAT CONTAIN PROBIOTICS

The discovery of the benefits of probiotics began with sour milk. Today we have many other options to get various bacteria from our foods, although it's not as simple as just adding them to the food. For there to be health benefits, the microorganism has to be able to survive the passage through the gastrointestinal tract, survive the food manufacturing process, and grow and survive during the ripening or storage period. Also, the bacteria must not negatively affect product quality and be included on the Generally Recognized as Safe (GRAS) list.
Most bacteria are included through the fermentation process. Fermentation helps extend the shelf life of perishable foods. It is a slow decomposition process of organic substances induced by microorganisms or enzymes that essentially convert carbohydrates to alcohols or organic acids. The lactic acid supplies the bacteria that then add the health benefits to the food. You can purchase foods that are fermented or ferment them yourself (Swain, 2014).

Kefir: This could be the most ideal probiotic dairy product because it contains both bacteria and yeast working together to provide the numerous health benefits. In a recent eight-week study, people with diabetes were given kefir milk containing Lactobacillus casei, Lactobacillus acidophilus, and bifidobacteria vs. conventional fermented milk. The hemoglobin A1C levels were significantly lower in the group consuming the kefir.

Kimchi: This fermented vegetable is made from Chinese cabbage (beachu), radish, green onion, red pepper powder, garlic, ginger, and fermented seafood (jeotgal). Many bacteria have been found to be present and can include any of the following: Leuconostoc mesenteroides and Lactobacillus plantarum, L. citreum, L. gasicomitatum, L. brevis, L. curvatus, L. sakei, L. lactis, Pediococcus pentosaceus, Weissella confusa, and W. koreensis. A recent review linked the health benefits of kimchi to anticancer, anti-obesity, anticonstipation, colon health promotion, cholesterol reduction, antioxidative and antiaging properties, brain health promotion, immune promotion, and skin health promotion.

Yogurt: It can contain Streptococcus thermophilus, Lactobacillus bulgaricus, L. acidophilus, and Bifidobacterium bifidum. Research has shown links with yogurt to have positive effects on the gut microbiota and is associated with a reduced risk for gastrointestinal disease and improvement of lactose intolerance (especially among children), type 2 diabetes, cardiovascular disease, allergies and respiratory diseases, as well as improved dental and bone health.

Sweet acidophilus milk: L. acidophilus and L. acidophilus plus bifidobacteria are added to make this milk.
Other foods without substantial research: miso (fermented soybean paste); tempeh; sauerkraut; aged soft cheese; sourdough bread; sour pickles; gundruk (nonsalted, fermented, and acidic vegetable product); sinki (indigenous fermented radish tap root food); khalpi (fermented cucumber); inziangsang (traditional fermented leafy vegetable product prepared from mustard leaves); soidonis (widespread fermented product prepared from the tip of mature bamboo shoots) (Swain, 2014).

MECHANISMS OF PROBIOTIC ACTION

Experimental models have revealed that probiotics differ greatly in their mechanism of action; any singular mechanism is unlikely to account for all of their clinical effects. Significant differences exist, not only between probiotic species, but also between certain strains. In addition to specific interactions between probiotic bacteria and host immune cells, microbe-microbe interactions confound the complexity of the signaling network in vivo. Such complex interactions probably account for the versatility of pro biotic action and could explain some of the varying results observed within the different clinical trials.
Understanding the various mechanisms of probiotic action is crucial for the establishment of definitive selection criteria for certain strains or combination of strains for specific clinical conditions. Although the molecular details of probiotic mechanisms remain unresolved, numerous studies have indicated that the beneficial effects of probiotics may be either direct or indirect through modification of the local microbiota, epithelial barrier function, intestinal inflammation, or the immune system (O'Hara *et al.*, 2007).

Mechanism of action by (O'Hara *et al.*, 2007)
FIGURE 1. Mechanisms of action of probiotics in intestinal diseases. In the intestine, immunosensory cells are continually sampling and responding to the microbiota. Pattern recognition receptors expressed by immunocytes

mediate the detection of bacterial antigens. Surface enterocytes sense danger signals and secrete immune mediators in response to antigens. Specialised epithelial cells, termed M cells, transport and deliver antigens to antigen-presenting cells, which in turn process antigens and present them to naïve T cells. Dendritic cells also survey and sample the mucosal microenvironment. Dendritic cells act as switches for immune responsiveness and determine the nature of the response by promoting either Th1 or Th2 effector cells or regulatory T cells and their associated cytokines. The figure illustrates several mechanisms of probiotic action that are relevant to intestinal diseases: A- competitive exclusion along the epithelium; B- modification of the local microenvironment; C- enhancement of epithelial barrier function; D- suppression of intestinal inflammation; E- modification of the host immune response. These mechanisms are strain specific and are not mutually exclusive. (AP-1, activator protein-1; Cl–, chloride; DC-SIGN- dendritic cell-specific intercellular adhesion molecule 3-grapping non-integrin; H2O2- hydrogen peroxide; IFN-, interferon; IgA-, immunoglobulin A; IL-, interleukin; NF-κB-, nuclear factor-κB, NO-, nitric oxide; PPAR-, peroxisome proliferator-activated receptor; TGF-, transforming growth factor; TNF-, tumour necrosis factor-α; Treg-, regulatory T cell.)

Competitive Exclusion Along The Epithelium

The intestinal epithelium is an important barrier that restricts the penetration of luminal antigens and microbes. Interaction between bacterial antigens and host cell receptors is a crucial step in the pathogenesis of many intestinal diseases. Preventing such interactions thus represents a potential therapeutic strategy. Several probiotic bacteria including bifidobacteria and lactobacilli adhere to mucosal tissue in a strain specific manner (Boudeau *et al.*, 2003). This limits nutrient availability to other bacteria, enhances the intestinal persistence of the probiotic bacteria, and limits pathogen access to the epithelium .

Genomics-based homology searches have led to the identification of several adhesion factors in probiotic bacteria (van Pijkeren, 2006)Surface structures, such as elongation factor Tu and GroEL of L. johnsonii LA1, and adhesins from other lactobacilli can bind epithelial cell mucins and mannose (Bergonzelli *et al*., 2006)

Enteropathogenic E. coli are known to bind to epithelial cells via mannose receptors. Therefore, it is feasible that probiotic strains with similar adherence capabilities could inhibit pathogen attachment at these or other binding sites, or impede the penetration of invasive pathogens across the mucosal layer. Moreover, GroEL has been shown to mediate the aggregation of H. pylori. Probiotics, such as L. bulgaricus, which adhere weakly to the intestinal mucosa, are less effective than adhesive strains against enteric pathogens.

Adhesive probiotic bacteria, such as L. plantarum 299v, L. acidophilus ATCC4356, and Streptococcus thermophilus ATCC19258 have been shown to prevent pathogen-induced electrolyte secretion and barrier dysfunction. However, these protective effects were only observed when the probiotics were added prior to pathogen challenge (Michail and Abernathy, 2003). There is evidence to indicate that particular combinations of probiotic strains may have synergistic adhesive effects, thereby increasing the efficacy of a probiotic preparation (Ouwehand *et al.,* 2000).

Modification Of The Local Microenvironment

Studies using in vivo expression screening technology have identified a variety of probiotic genes that are induced in the murine gastrointestinal tract. Such studies indicate that probiotic bacteria are responsive to gut conditions and metabolically active in vivo. Administration of probiotic bacteria can modify the composition of the local microenvironment in two key ways. First, probiotic bacteria mediate antimicrobial effects that can directly inhibit pathogenic bacteria; second, they enhance the richness and diversity of the more beneficial components of the gut microbiota . Probiotics have been shown to suppress pathogen growth through the release of a variety of antimicrobial factors. These include defensins, bacteriocins, hydrogen peroxide, nitric oxide, and short chain fatty acids, such as lactic and acetic acids, which reduce the pH of the lumen(Penner *et al.*, 2005).

The effects of the administration of probiotic bacteria on the indigenous mucosa-related microenvironment are poorly understood. Nevertheless, a number of recent studies demonstrate that probiotics play a role in the restoration or maintenance of a protective intestinal microbiota. In patients with pouchitis, VSL#3 therapy increased the diversity of the bacterial community, especially the anaerobic members, whereas the diversity of the fungal flora was repressed (Kuhbacher *et al.*, 2006). In contrast, patients who relapsed in the placebo group showed reduced microbial diversity. In a randomised, double-blind, placebo-controlled trial, the administration of L. johnsonii LA1 to healthy volunteers was found to increase total numbers of bifidobacteria and lactobacilli, as well as faecal lactic acid concentrations. This was coupled with decreased faecal pH and reduced numbers of clostridia. By inhibiting the adverse components and promoting the beneficial components, probiotic bacteria favourably modify the local microbiota (Yamano *et al*., 2006).

Enhancement of Epithelial Barrier Function

Alterations in epithelial transport and barrier functions are a common consequence of a variety of intestinal disorders including enteric infections. Defects in epithelial barrier function may also precede the onset of inflammation in patients with inflammatory bowel disease (Irvine and Marshall, 2000).

In contrast, commensal bacteria help to fortify the epithelial barrier by various mechanisms. For example, colonisation of germ-free mice with the commensal bacteria, Bacteroides thetaiotaomicron, induces the expression of the complement-inhibitor, decay-accelerating factor and complement-reactive protein-ductin, a putative receptor for cytoprotective intestinal trefoil factors (Hooper and Gordon ,2001). Exposure of colonic epithelial cell lines to bacterial ligands also results in apical tightening and sealing of tight junctions and increased trans-epithelial resistance (Cario *et al.*, 2004).

Several probiotic bacteria have been shown to preserve epithelial barrier function and prevent and repair mucosal damage triggered by food antigens, drugs (such as aspirin), enteric pathogens, and pro-inflammatory cytokines (Rosenfeldt *et al.*, 2004).

These protective effects are mediated by a number of mechanisms. These include the induction of mucin secretion, the maintenance or enhancement of cytoskeletal and tight junction protein phosphorylation, the restoration of chloride secretion, and the augmentation of transepithelial resistance . VSL#3 has been shown to up-regulate heat shock proteins known for their ability to maintain cytoskeletal integrity and protect intestinal enterocytes from injury against oxidative stress (Petrof *et al.*, 2004). Mitogen-activated protein kinases have been implicated in the induction of heat shock proteins by soluble factors from L. rhamnosus GG (Tao *et al.*, 2006) Lactobacillus rhamnosus GG can also exert mitogenic effects by increasing cell proliferation in the villi of germ-free rats, thereby enhancing mucosal regeneration. Moreover, probiotic bacteria can promote cell survival by preventing apoptosis(i.e. a type of cell death in which the cell uses specialized cellular machinery to kill itself) in intestinal epithelial cells through the regulation of both anti- and proapoptotic signal transduction pathways(Yan *et al*., 2002).

Together, these varying effects on the epithelium may be instrumental in improving mucosal barrier function and integrity. It is noteworthy that in a study of cytokine-induced barrier dysfunction, a commensal strain, B. thetaiotaomicron, was unable to reproduce all of the protective effects mediated by L. acidophilus ATCC4356 and S. thermophilus ATCC19258. This emphasizes that bacteria selected for their probiotic properties may have special abilities that are not necessarily shared by other commensal bacteria(Resta-Lenert and Barrett, 2006).

Suppression of Intestinal Inflammation

Intestinal epithelial cells sense danger signals within the luminal microenvironment. The transcription factor, nuclear factor (NF)-κB, is a master coordinator of immune and inflammatory responses to pathogenic bacteria and other stress signals. However, most commensal bacteria do not activate NF-κB. Instead, some commensal bacteria antagonise NF-κB within enterocytes by a variety of mechanisms. These include degradation of the NF-κB inhibitor IκB-α, or by the nuclear export of the p65 subunit of NF-κB in a peroxisome proliferator-activated receptor (PPAR) γ-dependent manner(Kelly *et al*., 2004).

The anti-inflammatory effects of a number of probiotic bacteria including Bifidobacterium infantis 35624 and L. salivarius UCC118 have been shown also to be mediated, at least in part, via NF-κB. Soluble components from VSL#3 can inhibit IκB degradation by inhibiting epithelial proteasome function. Lactobacillus reuteri has been shown to inhibit the nuclear translocation of NF-κB by preventing the degradation of IκB. This was accompanied by an increased expression of nerve growth factor, which has anti-inflammatory properties. This finding implicates a role of the enteric nervous system in host-microbial interactions (Ma *et al*., 2004).

HEALTH BENEFITS OF PROBIOTICS

Gastrointestinal Benefit

Probiotics may seem new to the food and supplement industry, but they have been with us from our first breath. During a delivery through the birth canal, a newborn picks up the bacteria Bacteroides, Bifidobacterium, Lactobacillus, and Escherichia coli from the mother. These good bacteria are not transmitted when a Cesarean section is performed and have been shown to be the reason why some infants born by C-section have allergies, less than optimal immune systems, and lower levels of gut microflora.

Probiotics are believed to protect us in two ways. The first is the role that they play in our digestive tract. We know that our digestive tract needs a healthy balance between the good and bad bacteria, and it looks like our lifestyle is both the problem and the solution. Poor food choices, emotional stress, lack of sleep, antibiotic overuse, other drugs, and environmental influences can all shift the balance in favor of the bad bacteria.

When the digestive tract is healthy, it filters out and eliminates things that can damage it, such as harmful bacteria, toxins, chemicals, and other waste products. The healthy balance of bacteria assists with the regulation of gastrointestinal motility and maintenance of gut barrier function. Research has shown some benefits for the use of probiotics for infectious diarrhea, antibiotic-associated diarrhea, gut transit, IBS, abdominal pain and bloating, ulcerative colitis, Helicobacter pylori infection, nonalcoholic fatty liver disease (NAFLD), and necrotizing enterocolitis (Hadhazy, 2010).

The other way that probiotics help is the impact that they have on our immune system. Some believe that this role is the most important. Our immune system is our protection against germs. When it doesn't function properly, we can suffer from allergic reactions, autoimmune disorders (for example, ulcerative colitis, Crohn's disease, and rheumatoid arthritis), and infections (for example, infectious diarrhea, H. pylori, skin infections, and vaginal infections). By maintaining the correct balance from birth, the hope would be to prevent these ailments. Our immune system can benefit anytime that balanced is restored, so it's never too late (Meini, 2015).

Research into the benefits of probiotics has been branching out, and new areas are emerging. Preliminary research has linked them to supporting the health of the reproductive tract, oral cavity, lungs, skin and gut-brain axis, and the prevention and treatment of obesity and type 1 and type 2 diabetes (Guarner, 2003; López, 2015)

Immune Health

Probiotics have also been researched for how they support the immune system. Studies suggest that probiotics can improve how the immune system functions such as by decreasing upper respiratory tract infections in adults and reducing the need for antibiotics. Studies in children show that a regular diet including probiotics reduces colds and flu-like symptoms and improves attendance in preschool and day care settings.

Maintaining a healthy immune system is important for everyone. In other words, probiotics provide an additional tool to help the body protect itself from getting sick. (Guarner, 2003)

The major cellular effectors of innate immunity include epithelial cells, phagocytic cells (monocytes, macrophages, and neutrophils), and natural-killer cells (NK-cells). Probiotics have been found to modulate the functions of all these cells (Gill and Guarner, 2004). Acquired immunity comprises antibody- and cell-mediated responses and is characterized by its specificity and memory. Consumption of specific probiotics has been shown to enhance antibody responses to natural infections and to immunizations. For example, Kaila and colleagues (1992) found significantly higher levels of specific antibody responses in children with rotavirus if the children consumed L. rhamnosus GG-fermented milk. Cytokines are the largest and most diverse group of immune response mediators. Initiation, maintenance, and resolution of both innate and acquired immune responses are regulated by cytokines. The ability of probiotics to induce cytokine production by a range of immune cells may explain how they are able to influence both innate and acquired immune responses.

Lactose intolerance

According to The Harvard Medical School Family Health Guide Sept. 2005, It is well known that people with lactose intolerance can often consume yogurt with few symptoms. This is because the probiotics in yogurt help digest the lactose in the small intestine, before it reaches the colon. In addition, the yogurt starter cultures L. bulgaricus and Streptococcus thermophilus help to break down the lactose. Because of its probiotics, yogurt is a good way for people with lactose intolerance to consume the recommended servings of dairy without experiencing uncomfortable symptoms they may get from other dairy products.(Marteau *et al.*, 1990)

Producing Antimicrobial Substances

Several probiotic bacteria have been shown to produce a range of antimicrobial substances including organic acids (lactic acid and acetic acid), hydrogen peroxide, carbon dioxide, and diacetyl, as well as bacteriocins and bacteriocin-like substances (Mishra and Lambert, 1996; Ouwehand *et al.*, 1999). Both lactic and acetic acids inhibit microbes by decreasing the pH of the intestinal contents, which retards every aspect of bacterial metabolism (Mishra and Lambert, 1996). Hydrogen peroxide inhibits the growth of both Gram-positive and Gram-negative bacteria (Hollang *et al.*, 1987; Mishra and Lambert, 1996). Diacetyl exerts its growth-inhibitory effect by interfering with arginine utilization by reacting with arginine-binding proteins (Jay, 1986).

Bacteriocins are defined as proteins or protein complexes of high molecular weight produced by certain bacteria that kill bacteria, usually closely related to the strain producing the bacteriocin (Klaenhammer, 1988). Probiotic bacteria have been shown to produce two types of antibacterial substances: low molecular weight antimicrobial substances (e.g., reuterin, produced by L. reuteri) and bacteriocins (Ouwehand, 1998). Whether all or some of these substances are produced by these bacteria once they are inside the host is not known. Recently, however, Corr and colleagues (2007) documented that an anti-Listeria activity observed in animals fed a bacteriocin-producing strain of Lactobacillus salivarius was lost in mutants no longer able to produce the bacteriocin. This is the first definite proof that pathogen inhibition results directly from bacteriocin production by the probiotic.Pathogens including E. coli, Salmonella, Campylobacter, Shigella, Vibrio, Clostridium, Candida albicans, human immunodeficiency virus, and other viruses have been inhibited in laboratory tests or animal studies by bacteriocin-producing probiotic strains (O'Sullivan and Kullen, 1998). But proof that the bacteriocin—and not some other cell function—mediates observed antipathogenic effects in vivo still is needed for most examples of bacteriocins.

SIDE EFFECTS OF PROBIOTICS

It appears that most people do not experience side effects from probiotics or have only mild gastrointestinal side effects such as gastritis . But there have been some case reports of serious adverse effects, and research on safety is ongoing. A 2008 review of probiotics safety noted that Lactobacillus rhamnosus GG has been widely studied in clinical trials for a variety of conditions and generally found to be safe. Nevertheless, a recent review of Lactobacillus and Bifidobacterium noted that the long-term, cumulative effects of probiotics use, especially in children, are unknown, and also pointed to evidence that probiotics should not be used in critically ill patients. Cases of infection due to lactobacilli and Bifidobacterium are extremely rare and are estimated to represent 0.05 -0.4% of cases of infective endocarditis and bacteraemia (Gasser, 1994). Similarly, a 2011 Agency for Healthcare Research and Quality assessment of the safety of probiotics, partly funded by NCCAM, concluded that the current evidence does not suggest a widespread risk of negative side effects associated with probiotics. However, the data on safety, particularly long-term safety, are limited, and the risk of serious side effects may be greater in people who have underlying health conditions.

Concerns have also been raised about the quality of probiotic products. Some products have been found to contain smaller numbers of live microorganisms than expected. In addition, some products have been found to contain bacterial strains other than those listed as ingredients. (Hempel *et al*., 2011).

Conclusion

Probiotic is relatively new and is currently used when we refer to bacteria associated with beneficial effects on humans and animals. The discovery of the benefits of probiotics began with sour milk. Today we have many other options to get various bacteria from our foods, although it's not as simple as just adding them to the food. For there to be health benefits, the microorganism has to be able to survive the passage through the gastrointestinal tract, survive the food manufacturing process, and grow and survive during the ripening or storage period.

Probiotics are of vital importance to our daily life. From the reviews and various publications it has been established that probiotics will help mankind in these days of stress, inconsistent dieting, processed foods, environmental hazards etc that have exposed human beings to various health challenges.

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