# Emerging Science, Emerging Market: The Growing Interest in Probiotics

By Peter Leighton

The intestines are teeming with over 100 trillion bacteria, constantly competing with each other. Many of these bacteria are helpful and necessary for digestion and healthful immune response, but some are harmful and invasive. Many factors affect this balance of power in the gut, including environmental and dietary influences. Age, stress levels, exercise, diet and use of medications all have an impact.

When there is a “good” balance of microflora in the gut, the body is more effective in the absorption of many nutrients, better able to repress the growth of harmful bacteria that cause illness, form a protective barrier that keeps harmful bacteria and pathogens from entering the blood stream, and actually train the immune system to better respond to pathogens.

When this balance is disrupted, common symptoms can include flatulence, bloating, cramping, constipation and/or diarrhea, malaise, and can lead to more chronic conditions such as Irritable Bowel Syndrome (IBS), Chronic Fatigue Syndrome and a compromised immune system.

As science begins to unravel the mystery surrounding the amazing health benefits of probiotics (healthy bacteria), more and more consumers are being drawn to products that can deliver them. But before we explore the rise of probiotics, the future of functional foods and new applications of probiotics, perhaps a bit of background on probiotics is in order.

## The Seeds of Probiotics

Nobel Laureate Elie Metschnikof studied the longevity of Balkan peasants, who

ate a diet consisting of large quantities of fermented milk. In theorizing why they had such robust lifespan, he suggested that aging was a result of proteolytic

microbes producing toxins in the large bowel. As the body digests proteins, these proteolytic bacteria produce toxic by-products including phenols, indols and ammonia. As it turns out, the lactic acid in fermented milk inhibits the growth of the proteolytic bacteria. Metschnikof believed that fermented milk would seed the intestine with “healthy” bacteria (lactic acid) and thus suppress the growth of “bad” bacteria.

From this early theory of bacterial homeostasis in the gut, the study of probiotics began to take root. But not until the last 50 years has advanced science truly leveraged these learnings into practice, seeding a prolific industry based around the introduction of “good” bacteria to the gut.

80% of our immune system resides within the digestive tract, hosting as many as 500 different *species* of bacteria.  About 100 trillion bacteria exist within the body – more than 10 times the number of cells we have in our entire body.

As noted, some of these bacteria are referred to as “good”, but others provide very little benefit. The ideal balance between them is 85% beneficial and 15% "other". This ratio between "good" beneficial bacteria and “other” bacteria becomes one of the critical factors determining optimal health. It is important to understand that each probiotic strain is different and confers unique benefit.

## Some of the beneficial effects of probiotics include:

- Since lactic acid bacteria convert lactose into lactic acid, several strains of probiotics have demonstrated benefit to individuals who are lactose intolerant.

- The presence of probiotics vastly improves digestion and nutrient absorption.

- Lower incidence of colon cancer among higher consumers of probiotics has led to clinical research in this area. Several studies have found certain probiotic strains exert anti-carcinogenic effects. Some pre- and probiotics may suppress the activity of certain enzymes in the colon, possibly reducing the production of toxic and carcinogenic metabolites, according to a study published in *European Journal of Clinical Nutrition*.

- Probiotics reduce the levels of microorganisms such as E.coli, and salmonella in the gut, and they restrict pathogens ability to release into the bloodstream. A study published in *The Lancet* showed that 59% of subjects did not develop rotaviral diarrhea when probiotic was administered before infection. The meta-analysis showed that the risk of necrotizing enterocolitis, one of the most common gastrointestinal problems in premature babies, might be cut by 74% with probiotic supplementation. They also observed a 53% reduction in the risk of mortality.

- Both acute and travelers diarrhea are effectively treated with probiotics, and several strains have been effective at treating antibiotic-associated diarrhea. The *British Medical Journal* published a study demonstrating a 22% drop in the number of cases of diarrhea if probiotic drinks were consumed by hospital-bound elderly patients who were receiving antibiotics.

- Preliminary research is showing some probiotics to effectively aid in the treatment of helicobacter pylori, an infection linked to peptic ulcers.

- Inflammatory bowel disease can be modulated by probiotic consumption, as well as other inflammatory allergic responses.

- Several probiotic strains have demonstrated improvement in treating irritable bowel syndrome and colitis, although there are only a handful of probiotic products on the market claiming to target the condition. IBS affects between 10 and 15 per cent of the population. Furthermore, a series of probiotic studies on mice have presented positive results in protecting newborns from intestinal infections and reducing inflammatory bowel disease. Probiotics may boost the number of bowel movements and relieve constipation, suggests a pilot study from the Netherlands.

- Some clinical studies have demonstrated probiotic's ability to lower cholesterol, as it seems to inhibit re-absorption.

- Probiotic milk has shown an ability to reduce blood pressure.

- Probiotics protect against pathogens and help stimulate immune response. They also have demonstrated an ability to reduce respiratory tract infections and severity and duration of rotavirus infections. A study published in the *British Medical Journal* showed that children who drink probiotic milks have lower incidences of respiratory illnesses than those who do not drink the milks. The study showed a 17% reduction in the

occurrences, as well as a reduction in the number of antibiotic prescriptions.

- Workers who take probiotics daily are less likely to be off work with common illnesses, such as colds and gastroenteritis, than workers who don't. An exploratory study published in the open access journal *Environmental Health* shows that workers who took a daily dose of probiotic bacteria were 2.5 times less likely to take sick leave than workers who took a placebo. Supplementation of probiotics can reduce the duration of the common cold by nearly a quarter, research has suggested. One study published in *Clinical Nutrition* compared the effects of probiotic supplements with standard vitamins and minerals and found that the probiotic bacteria shortened episodes of the common cold and reduced the severity of symptoms.

- Probiotic bacteria could not only help fight viruses but they may also protect against autoimmune diseases like diabetes. Results from a clinical trial showed higher numbers of different types of white blood cells after subjects had consumed probiotics. Increased white blood cells have been linked to the protection against type 1 diabetes.

- Several studies confirm probiotic benefit in the treatment of urinary tract infections and bacterial vaginosis.

- Studies have shown some probiotics promote oral health by killing the bacteria that foster dental carries.

- Probiotics produce short chain fatty acids that are converted into energy.

Not all probiotics are the same. There are basically two different genus of commercial probiotics, and many unique strains of each.

Lactobacillus is one of the most common and well-known genus of probiotic bacteria. It contains about 80 recognized species, with the most well known being Lactobacillus acidophilus. They produce lactic acid from fermentable sugars such as glucose, fructose, lactose and/or galactose. The major by-products of lactobacilli fermentation are lactic and acetic acids.

Bifidobacterium is the most abundant genus of good bacteria in the human gastro-intestinal tract. The major by-products of bifidobacteria fermentation are lactic, acetic, and butyric acids; additionally succinic acid can also be produced by some strains of bifidobacteria.

Given that *bifidobacteria* are present in human breast milk, it follows that pediatric health has been one of the foci of probiotic research. Martin Martin, MD, a pediatrics professor at David Geffen University in Los Angeles drew attention to the rise in allergies and autoimmune diseases in children, and suggested that studying the role of microflora is crucial in efforts to combat this trend. It seems that measures intended to improve public health, such as food pasteurization and sterilization and use of antibiotics results in a decreased exposure to microorganisms - leading to a gap in colonization and weaker defenses against disease. It is believed that probiotics could act as surrogate colonizers in such cases.

Lactose intolerance is a significant problem for many people as they age, none more so than Asians. It's of note that the largest market for probiotics today is the Asian-Pacific market, where dairy consumption is also steadily rising. Since probiotics break down the excess lactose, there is exceptional opportunity for continued growth of a host of probiotic product platforms. For instance, Ganeden Biotech was granted a new patent for a novel two-prong approach product called Digestive Advantage Lactose Intolerance, which combines the lactase enzyme with a probiotic bacteria strain.

## Probiotics in Practice

While probiotic rich foods have been consumed for centuries, the last century has seen a marked interest in the concept of active microbial ingredients effect on the gastrointestinal system and their positive effect on human health. Recently, probiotics have become more recognized and desired as consumers have sought out natural products that contribute to both nutrition and health. Further research and publicity of their benefit towards intestinal health, lactose digestion, cholesterol reduction, yeast infection reduction, immune stimulation and control of cancer have made probiotics of greater interest to consumers.

Because of their inability to survive passage through the stomach, most basic yogurt cultures are not able to provide significant benefit. This problem of survivability through the harsh digestive process has been one of the biggest reasons why probiotics took so long to gain favor among the masses. But as research has advanced, industry now has several robust probiotic strains that are proving successful not only in surviving digestion, but also surviving the manufacturing process that would otherwise kill most strains of bacteria. And these advanced probiotics are

addressing another issue that has hampered the advancement of probiotics in the marketplace: shelf stability.

The emerging science in probiotics is two-fold. First, better characterization of the clinical benefits of single strain probiotics is accelerating. Second, research into multiple probiotic strains is increasing as the human gut is home to over 500 different bacteria and different probiotic strains populate and affect different parts of the digestive tract. Technological advances in micro-encapsulation and nano-polymers are helping to solve some of the issues surrounding shelf stability and survivability, as is advancement into identifying and developing new strains that maintain integrity.

Increased digestive problems and antibiotic side effects have paved the road for the rising demand for probiotics worldwide. Research advances validating a host of other probiotic benefits is only accelerating that growth. And while many consumers may not fully understand the mechanisms of action and how probiotics work, nor do they understand the varying strains, they are nonetheless interested in trying products that contain them.

## The Probiotic Market

Europe and Asia have been leaders in terms of awareness and sales of probiotic products, while North America rapidly gains ground. Americans in particular have been hesitant to discuss gut health issues but are now finding a voice and reason. While consumers have a strong perception of probiotics as “healthy”, few understand the specific benefits, let alone the science behind them. The strong association between probiotics and yogurt is both blessing and curse. Thanks to the marketing efforts of major yogurt brands such as Yakult, Activia and Actimel, more and more consumers are gaining awareness of probiotics.

While still in its infancy, the global probiotics market is forecast to reach $28.8 billion by 2015, according to a new report from Global Industry Analysts, Inc. This growth in probiotic products has been accelerating in recent years. According to Mintel’s Global New Products Database, in 2007 there were 136 new probiotic products launched, an increase of 131% from the previous year. In fact, global consumption volume of probiotics is more than three times that of omega-3, making probiotic cultures the most successful functional ingredient in packaged

foods after vitamins and minerals.

The Asia-Pacific region accounted for half of global probiotic culture consumption in 2009, followed by Western Europe. Due to its relative immaturity, North America trails behind, claiming less than 10% of global volumes, but witnessing the most dynamic volume growth.

In the United States, a recent market research survey by ConsumerLab showed that approximately 30% of respondents used probiotics, up from 25% last year. Similarly, one-third of women in the survey reported using a probiotic. At the same time, Natural Marketing Institute (NMI) found that 70% of consumers don't know any specific health benefits of probiotics—underscoring the point that awareness doesn't equal understanding.

The US probiotics market has grown 8.7% over the past 5 years, and is expected to grow at a compound annual growth rate (CAGR) of 13.7%. The fastest-growing sector within this market is probiotic beverages with a CAGR of 24.6%.

## Probiotic Beverages

Beverage applications have proven to be very strong for all functional foods, and probiotics are key among them. Early beverage applications included "drinkable" yogurts and kefir products, and quickly migrated to the popular smoothie market. More recently probiotics have expanded into fruit juice based beverages and other RTD beverage bases including soymilk and coconut water.

There are several formulation application obstacles with probiotics. As living organisms, probiotics are very sensitive to heat, moisture and pH, which can severely limit what kind of products they may be added to. Many beverages require pasteurization, a process designed to kill bacteria, and other beverages have very acidic pH, which also destroys the probiotic. If the probiotic strain cannot thrive in the beverage while it is on the shelf, without negatively affecting taste or consistency, the beverage will not be successful.

Several technological advancements have helped to overcome these challenges and are now found in new beverage applications. BioGaia introduced a straw that is embedded with probiotics. The straw is inserted into the aseptic beverage container and the consumer gains the benefit of the probiotic as the liquid passes through the straw and is ingested. Another interesting application, which similarly has separated the probiotic strain from the liquid until the last moment, is the LifeTop bottle cap, used by phd brand probiotic waters. This is a technology that maintains the probiotic into a chamber in the cap of the bottle, only to be pierced and integrated into the liquid at the last moment before consumption.

Powdered beverage mixes are an excellent alternative that allows for better shelf stability of the probiotic, as it is devoid of liquid until mixed before consumption.

As consumers have taken fancy to “on-the-go” stick packs (sachets), a whole category of individual drink mixes has been growing vigorously. MojoMilk™ is the first probiotic chocolate milk mix that is packaged in this manner, and utilizes the advanced GanedenBC30 *bacillus coagulans* strain of probiotic, ideal for children’s health benefit and it remains vibrant through manufacturing and digestion.

Probiotic beverages have outstanding potential for continued growth. As industry has been meeting the technological challenge, the limiting factor in market growth seems to reside with the various (and often inharmonious) regulatory bodies. Probiotics are dependent upon regulatory acceptance for human consumption, but more importantly, it is the regulators who must approve of the health claims used to market these products. Whether the EFSA (EU), FSANZ (Australia, New Zealand), NHPD (Canada), FDA/FTC (USA), FSSA (India), FSC (Japan), or SFDA (China), there seems to be no harmony as to probiotic health claims. Without some stable and predictable regulatory parameters, the ability to provide useful and accurate health information to consumers becomes very challenging and certainly limits market potential.

However, those consumer probiotic products that are able to transcend the health benefit conundrum by offering a great tasting and convenient product that stands on its own sans any health “claim” are assured an outstanding opportunity for success. As with any functional food, the road to success must travel through the consumer’s taste buds and vernacular of need, before it can offer the added value of good health.