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Review Article

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## Nutritional Regimen of Synbiotics in Managerial Dietetic Contrive for Healthy Lifestyle

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### ABSTRACT

The benefits of probiotics & prebiotics are supported by all-embracing research. Probiotics have been extensively researched since their documentations. This research has typically been done at research-oriented universities, often in Europe where awareness of prebiotics is uppermost. Probiotics are already in use for the wide array of beneficial effects that they can produce particularly with respect to the diseased condition. The potential areas which the use of synbiotics can target include the alteration in the colonic microbiome content, changes in insulinemia, fatty acid metabolism modifications, improvements in the absorption and bioavailability of the dietary minerals like Ca, Zn & Fe. The exerted negative influence on colon cancer is another area of potential future research. Besides, the breakdown of inulin like polysaccharides by the probiotics results in the synthesis of a number of low energy sugar molecules which can also be quite interesting from the point of food product development. Such evidences have come up in experiments to assess the combined role of inulin and bifidobacteria as anticancer agents. Insufficient or at most preliminary evidence exists with respect to cancer prevention, a so-called hypocholesterolemic effect, improvement of the mouth flora and caries prevention or prevention or therapy of ischemic heart diseases or amelioration of autoimmune diseases (e.g. arthritis). A prebiotic is "a selectively fermented ingredient that allows specific changes, both in the composition and/or activity in the gastrointestinal microflora that confers benefits upon host well being and health", whereas synergistic combinations of pro- and prebiotics are called synbiotics. Today, only bifidogenic, non-digestible oligosaccharides (particularly inulin, its hydrolysis product oligofructose, and (trans) galactooligosaccharides), fulfill all the criteria for prebiotic classification. They are dietary fibers with a well-established positive impact on the intestinal microflora. Other health effects of prebiotics (prevention of diarrhoea or obstipation, modulation of the metabolism of the intestinal flora, cancer prevention, positive effects on lipid metabolism, stimulation of mineral adsorption and immunomodulatory properties) are indirect, i.e. mediated by the intestinal microflora, and therefore less-well proven. In the last years, successful attempts have been reported to make infant formula more breast milk-like by the addition of fructo- and (primarily) galactooligosaccharides.

**Keywords:** Super duos natural products, probiotics, prebiotics, bifidobacteria, microflora, oligofructose

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## 1. Introduction

Nutrition research has pinpointed specific functional components of foods that may improve health, and prebiotics and probiotics are two such substances. Though they are available as dietary supplements, it is not necessary to use special pills, potions, cleanses or other concoctions to incorporate prebiotics and probiotics into your diet. These "nutrition boosters" are natural ingredients in everyday food. When there is excessive use of antibiotics, which leads to imbalance between the beneficial and harmful microorganisms, making our body more susceptible to infections, Probiotics living micro-organisms are added to food which beneficially affect the host by improving its intestinal microbial balance and Prebiotics are the non-digestible dietary supplements are used, which modify the balance of the intestinal microflora by stimulating the growth and activity of beneficial organisms.

Combination of probiotics and prebiotics beneficially affect the host by improving the survival and implantation of live microbial dietary supplements into the gastrointestinal flora and by improving the microbial balance of the gastrointestinal tract, thus effectiveness of combining probiotics and prebiotics may have additive and synergistic effect. In the last few years, great attention has been dedicated to probiotics and prebiotics or their combined use (synbiotics) in improvement of human health in a natural way because of their history of safe use and the general body of evidence that supports their positive roles. Such synbiotics indicate a realistic way of using biological preparations in the prevention of diseases in humans. Probiotics "live micro-organisms" confer a health benefit on the host when administered in adequate amounts."

The major source of probiotics for humans is dairy-based foods containing intestinal species of *Lactobacillus* or *Bifidobacterium*. The most common type used is *Lactobacillus acidophilus* "friendly bacteria", a species of Gram-positive, rod-shaped bacteria often found in the intestinal tract of humans and animals, the human mouth and vagina. It is an anaerobic organism that produces lactic acid which reduces the pH. This may have an inhibitory effect on other organisms, especially candida. The yeast *Saccharomyces cerevisiae* and some *Escherichia coli* and

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*Bacillus* species are also used as probiotics. Prebiotics "selectively fermented ingredients" are non-digestible carbohydrates (mainly oligosaccharides and non-starch polysaccharides) which act by promoting the growth and/or activity of probiotic bacteria in the gut. The most common are fructo-oligosaccharides (FOS), inulin and galacto-oligosaccharides. They are found in various vegetables and fruit such as tomatoes, onions, garlic, leeks, asparagus and bananas. Prebiotics are relatively stable and, unlike probiotics, can be relied on to arrive relatively unchanged in the gut despite the presence of digestive enzymes. Other health effects of prebiotics (prevention of diarrhoea or obstipation, modulation of the metabolism of the intestinal flora, cancer prevention, positive effects on lipid metabolism, stimulation of mineral adsorption and immunomodulatory properties) are indirect, i.e. mediated by the intestinal microflora, and therefore less-well proven. In the last years, successful attempts have been reported to make infant formula more breast milk-like by the addition of fructo- and (primarily) galacto oligosaccharides (de Verse & Schrezenmeir, 2008).

The National Institute for Health and Care Excellence (NICE) evidenced that probiotics shorten duration of acute diarrhoeal illness, and improve symptoms, but the latest review concluded studies varied and more research was needed.[2] Prophylaxis of antibiotic-associated diarrhoea. Studies vary, and ongoing research into the dose of probiotics continues, but there is evidence that probiotics may prevent some antibiotic-associated diarrhoea.[3][4] There is evidence that probiotics are safe and effective in preventing *C. difficile* diarrhoea.[7] Induction or maintenance of remission in Crohn's disease. Evidence suggests little benefit and further research is needed.[9][10][11] There is possibility of benefit, but evidence is equivocal and further research is needed.[12][13] There is some evidence that probiotics may improve symptoms of IBS, although ongoing studies are needed to identify which patients benefit, and optimal regimens.[1][16] Eradication of *Helicobacter pylori*. A meta-analysis concluded that fermented milk-based probiotic preparations increased eradication rates in patients on standard eradication therapy by 5-15%.[18]. Probiotic

therapy reduced both the incidence and severity of this condition in a study of very low birth weight infants.[19][20] Prebiotics may improve gastrointestinal (GI) health as well as potentially enhance calcium absorption. Prebiotics include fructo-oligosaccharides (FOS), such as inulin and galacto-oligosaccharides (GOS). But rather than focusing on these lengthy words, include more prebiotics in your diet by eating these foods recommended by King: bananas, onions, garlic, leeks, asparagus, artichokes, soybeans and whole-wheat foods. Probiotics are actually the "good" bacteria — or live cultures — just like those naturally found in your gut. These active cultures help change or repopulate intestinal bacteria to balance gut flora. This functional component may boost immunity and overall health, especially GI health. For instance, probiotics have been used for treatment of irritable bowel syndrome. Some strains of these live cultures may help prevent specific allergy symptoms, reduce symptoms of lactose intolerance and more. However, effects can vary from person to person.

Products that combine these together are called synbiotics. On the menu, that means enjoying bananas atop yogurt or stir frying asparagus with tempeh is a win-win. So be sure to include food sources of prebiotics and probiotics on your grocery shopping list, taking time to double check labels at the market. Although you won't find a Food and Drug Administration (FDA) health claim on products that provide these "nutrition boosters," you may find a structure-function claim such as "promotes a healthy digestive system." The bottom line: At minimum, prebiotics and probiotics are keys for good gut health. Basically, incorporating health-promoting functional foods, such as foods containing prebiotics and probiotics, into the diet potentially aids in creating a healthier you. Numerous probiotic microorganisms (e.g. *Lactobacillus rhamnosus* GG, *L. reuteri*, bifidobacteria and certain strains of *L. casei* or the *L. acidophilus*-group) are used in probiotic food, particularly fermented milk products, or have been investigated--as well as *Escherichia coli* strain Nissle 1917, certain enterococci (*Enterococcus faecium* SF68) and the probiotic yeast *Saccharomyces boulardii*--with regard to their medicinal use. Among the numerous purported health benefits attributed to probiotic bacteria, the (transient) modulation of the intestinal microflora of the host and the capacity to interact with the immune system directly or mediated by the autochthonous microflora, are basic mechanisms. They are supported by an increasing number of in vitro and in vivo experiments using conventional and molecular biologic methods. In addition to these, a limited number of randomized, well-controlled human intervention trials have been reported. Well-established probiotic effects are (de Verse & Schrezenmeir, 2008): Prevention and/or reduction of duration and complaints of rotavirus-induced or antibiotic-associated diarrhea as well as alleviation of complaints due to lactose intolerance.

- Reduction of the concentration of cancer-promoting enzymes and/or putrefactive (bacterial) metabolites in the gut.

- Prevention and alleviation of unspecific and irregular complaints of the gastrointestinal tracts in healthy people.
- Beneficial effects on microbial aberrancies, inflammation and other complaints in connection with: inflammatory diseases of the gastrointestinal tract, *Helicobacter pylori* infection or bacterial overgrowth.
- Normalization of passing stool and stool consistency in subjects suffering from obstipation or an irritable colon.
- Prevention or alleviation of allergies and atopic diseases in infants.
- Prevention of respiratory tract infections (common cold, influenza) and other infectious diseases as well as treatment of urogenital infections.

Preliminary research has demonstrated potential effects on calcium and other mineral absorption,<sup>[17]</sup> immune system effectiveness,<sup>[18]</sup> bowel pH, reduction of colorectal cancer risk,<sup>[19]</sup> inflammatory bowel disorders (Crohn's disease and ulcerative colitis)<sup>[20]</sup> hypertension<sup>[21]</sup> and intestinal regularity. Recent human trials have provided further evidence for the potential role of prebiotics in lowering risk of colon cancer.<sup>[22]</sup> It has been argued that many of these health effects emanate from increased production of short-chain fatty acids (SCFA) by the stimulated beneficial bacteria. Thus food supplements specifically enhancing the growth of SCFA producing intestinal bacteria (such as clostridia and bacteroides species) are widely recognized to have such potential. While research does clearly demonstrate that prebiotics lead to increased production of these SCFA,<sup>[23]</sup> more research is required to establish a direct causal connection. It has been argued that prebiotics are beneficial to Crohn's disease through production of SCFAs to nourish the colon walls, and beneficial to ulcerative colitis through reduction of hydrogen sulfide gas due to reduction of sulfate-producing bacteria, which do not thrive in the slightly acidic environment SCFAs create.



**Figure 1**

The immediate addition of substantial quantities of prebiotics to the diet may result in an increase in gas, bloating or bowel movement. It has been argued that chronically low consumption of prebiotic-containing foods in the typical Western diet may exaggerate this effect. Human colonic bacteria substrates are relatively stable.

Production of SCFA and fermentation quality are reduced during long-term diets of low fiber intake.[24] Until bacterial flora are gradually established to habituate or restore intestinal tone, nutrient absorption will be impaired and colonic transit time temporarily increased with an immediate addition of higher prebiotic intake.[25] Although we often think of probiotics mostly in terms of dairy products like yogurt or kefir, there are all kinds of other probiotic foods as well. There's Japanese tempeh or natto, which are both made from fermented soy. There's Korean kim-chi, Polish sauerkraut and all kinds of other naturally fermented vegetables and pickles. Wine and beer both contain probiotics, and so does cheese-particularly aged cheeses like parmesan, cheddar, or gouda. In fact, virtually every traditional cuisine features some sort of fermented or cultured food. Scientists have long known that the human gut is home to a variety of different species of bacteria, which play some role in human health. However, recent research has revealed that the interactions between our bodies and those of our tiny symbiotic friends are much more complicated and have potentially greater impact than we ever realized.

For example, scientists have recently discovered that certain types of gut bacteria are more likely to be present in individuals with obesity. Also, eating foods that are thought to promote the growth of "good" gut bacteria has been shown to cause weight loss, lower blood pressure, and lower heart rate. Research on the interactions between this gut microbiota and human health have found links with not just obesity, but also Parkinson's Disease, allergies, and many other conditions. One question that scientists all agree is difficult to answer is whether or not gut microbiota are responsible for these interactions or merely correlated with them. In other words, do the microscopic organisms living in our guts contribute to the cause of these conditions or are they there because of the conditions. While more research is needed to answer that question, the role of microbes in controlling human health shouldn't be easily dismissed. Consider the following statistics: While there are just over 20,000 protein-coding genes in the human genome, researchers estimate that there are somewhere between 5 and 8 million different genes in the various microbes that inhabit our bodies. That's a potential ratio of 400 microbe genes acting in our bodies for every one of our own.

While not all of these genes would necessarily impact our bodies, even the possibility that a fraction of them could be cause for more research. Certain foods, such as chicory root and Jerusalem artichokes, are particularly high in prebiotics. Of course, these foods aren't exactly daily staples for most of us. Garlic, onions, and leeks—foods you're likely to eat on a more frequent basis—are also relatively good sources. And smaller amounts of soluble fiber are found in a wide range of foods, including fruits, vegetables, whole grains, bran, honey, and soybeans. Basically, everyone has bacteria living in their digestive tracts; some of it can make you sick, but other microbes actually can keep you healthy by keeping bad bacteria and

yeast at bay. Many strains of good probiotic bacteria already exist in your gut, helping you better digest food and improving your body's ability to absorb nutrients. When you take antibiotics for an infection, the drugs can kill off the good bacteria in your digestive tract, which is why many women get yeast infections when they take antibiotics. [01]

Probiotics and prebiotics can help the beneficial bacteria grow back. You need a balance of intestinal bacteria favorable to digestion in order for your body, especially the intestines, to utilize minerals and other nutrients from your food. This bacteria works off carbohydrates and sugars, often called fructo oligosacharrides, found in vegetables and fruits, a large part of a balanced diet. A balanced diet is essential for health to provide the nutrients needed for energy and vitality. A balanced diet consists of protein, carbohydrates, fiber, vitamins and minerals, and fats. The US Department of Agriculture reports that to be healthy each person needs to have 6-10 half-cup servings of vegetables and some fruits daily, and at least one serving must be raw. Whole grains should be the only kind of grain products eaten in a balanced diet. Even when following a balanced diet the proper balance of intestinal bacteria is essential or the nutrients in food and/or supplements cannot be utilized.

Probiotics and prebiotics are the solution to obtaining that balance of intestinal good bacteria. [02] Probiotics have been defined as viable microbial food supplements which beneficially influence the health of the host. Prebiotics are food ingredients that are largely undergraded in the small bowel and can beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria. In farm animals, probiotics and prebiotics may enhance growth and prevent early mortality, especially from infections. In humans, their potential 'nutritional advantages' consist of preventative curative effects against diseases including intestinal dysfunctions, gastro-intestinal infections, inflammatory bowel disease and possibly colon cancer. The evidence supporting nutritional advantages of probiotics and prebiotics is rapidly increasing.[03]

Probiotics and prebiotics have been considered as potentially inexpensive and safe intervention approaches that can be formulated into specialized foods, supplements, or pharmaceuticals that can in turn contribute to solving some of these health concerns. The health benefits and efficacy of probiotics and prebiotics are currently attracting much attention and research. They span a broad range, including improved gut performance, immune function, and mineral bioavailability. In food form, probiotics and prebiotics appeal to people interested in staying healthy, managing a health concern or reducing disease risk. Such 'functional foods' are part of a dietary approach to prophylactically managing health disorders in a way that is both user-friendly and attractive to the consumer. Adding beneficial live microbes (probiotics) or using non-digested food stuffs selective for beneficial indigenous microbes

(prebiotics) is gaining much popularity and credibility. [04] At this early stage of the scientific research into probiotics for children, it's not yet possible to know for sure which are the best strains and species of probiotics to give. The evidence that exists however suggests that the follow species and strains of probiotics are beneficial to children: *Bifidobacterium bifidum*; *Bifidobacterium lactis*; *Lactobacillus acidophilus*; *Lactobacillus reuteri*; *Lactobacillus rhamnosus*); *Saccharomyces boulardii* (probiotic yeast) Insufficient or at most preliminary evidence exists with respect to cancer prevention, a so-called hypocholesterolemic effect, improvement of the mouth flora and caries prevention or prevention or therapy of ischemic heart diseases or amelioration of autoimmune diseases (e.g. arthritis). A prebiotic allows specific changes, both in the composition and/or activity in the gastrointestinal microflora that confers benefits upon host well being and health", whereas synergistic combinations of pro- and prebiotics are called synbiotics. Today, only bifidogenic, non-digestible oligosaccharides (particularly inulin, its hydrolysis product oligofructose, and (Trans) galactooligosaccharides), fulfill all the criteria for prebiotic classification.

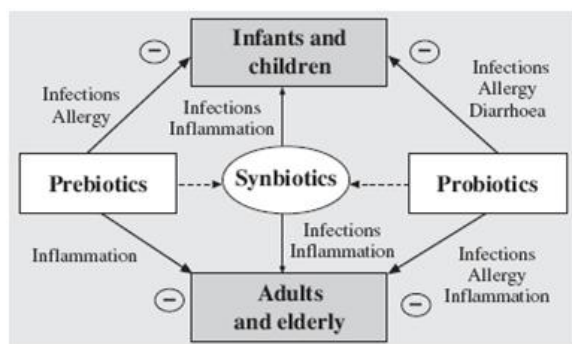


Figure 2

In short, the Prebiotic is a specialized plant fiber that beneficially nourishes the good bacteria already in the large bowel or colon. The body itself does not digest these plant fibers; instead, the fibers act as a fertilizer to promote the growth of many of the good bacteria in the gut. These, in turn, provide many digestive and general health benefits. The Prebiotin formula of prebiotic supplements contains both inulin and oligofructose. This full spectrum formula treats the entire bowel wall for maximum effectiveness. And Prebiotin has been proven by numerous independent scientific studies to increase the number of healthy bacteria in the colon, the benefits of which are impressive and essential to overall health and well being. There is no doubt that prebiotics and probiotics are an interesting group that warrants further investigation. Guidelines were produced in 2010 to guide ongoing research [31] Studies on one strain of micro-organism cannot be assumed to apply to others, and experimental studies have often not been extended to humans. Many brands of commercially produced probiotics and prebiotics exist, which are not standardised, and there is concern about the applicability of meta-analyses which extend to such heterogeneous groups of subjects, conditions and treatments.

Prebiotic fiber is found in many fruits and vegetables, such as the skin of apples, bananas, onions and garlic, Jerusalem artichoke, chicory root and beans. Sounds easy to get enough prebiotic fiber, right? Unfortunately, the minute amounts of fiber in each of these foods - such as 1 to 2 grams per serving - make ingesting enough fiber extremely difficult. Most people should consume at least 25 grams of fiber every day, and the foods highest in prebiotic fiber - chicory root is one such example - are nearly impossible to eat in large quantities every day. The good news is that adding a prebiotic fiber supplement to your diet is fast and simple. In supplement form, prebiotic fiber is also mild in texture and nearly tasteless, making it easy to add to water, cereal or any other food.

For years, hardly anyone in the medical profession paid any attention to the role the colon plays in overall health. Over the past 15 years, however, we have discovered that the colon - and specifically, the bacteria that call the colon home - is incredibly important to wellness. The healthy bacteria that live there strengthen the bowel wall, improve mineral absorption and aid in the regulation of hormone production, which has a range of essential benefits. Prebiotics fertilize these good bacteria as they stifle production of the bad, disease-causing bacteria, and Prebiotin prebiotic fiber is independently shown to cause the multiplication of beneficial bacteria.

If you think a strong bowel wall, improved mineral absorption and regulated hormone production doesn't sound important, consider the details: obesity, diabetes, bone density, cancer, heart health, anxiety, a large range of lower GI problems, and more can improve with copious amounts of beneficial bacteria in a healthy lower gut. Prebiotics research, especially over the past two years, has revealed that consuming a diet high in prebiotic fiber has a positive effect on each of these areas, with more discoveries coming every day.

Prebiotin prebiotic fiber is a full spectrum dietary supplement that contains oligofructose and inulin. These all-natural, plant-based fibers are independently shown to nourish the beneficial bacteria in the gut. Prebiotin won't go bad, it will survive the trip from your mouth to your lower gut intact, and it is easily added to a wide range of foods and drinks.

- Prebiotin does not contain dangerous or untested chemicals, and it is suitable for vegetarian and vegan diets.
- Prebiotics are a very special form of dietary fiber. Probiotics are living bacteria intended to benefit colon health.
- Prebiotic Fiber is not affected by heat, cold, acid or time. Probiotics can be killed by heat, acid or simply the passage of time.
- Prebiotics nourish the thousands of good bacterial species already living in the colon. Probiotics contain from one to a few species of bacteria

which are added to the colon when they are ingested (eaten).

- Prebiotic Fiber is a naturally-occurring substance, found in thousands of plant species (though mostly in very small amounts). Probiotics occur naturally in fermented foods like yogurt or sauerkraut.
- Prebiotics foster an environment in the colon which is hostile to bad bacteria. Probiotics may impact bad bacteria by crowding them out.
- The benefits of prebiotics are supported by extensive research. The benefits of probiotics are supported by extensive research
- Both Prebiotics and Probiotics must be ingested in sufficient quantity to have an impact, and should not carry an excessive "load" of sugar, calories, carbs, etc.
- Prebiotics are a very special form of dietary fiber. Probiotics are living bacteria supposedly beneficial to the colon.
- Prebiotics are nondigestible substances that pass through the stomach and small intestine unchanged. Thus far only two fructooligosaccharides: oligofructose and inulin, fully meet the complete medical definition of "prebiotic". The compound created from merging these two prebiotics together is called Oligofructose-Enriched-Inulin and is considered a "full-spectrum" Prebiotic.
- Some foods presented as "prebiotics" in and of themselves simply contain prebiotics. For example we often see honey presented as "a prebiotic," while it is more accurate to simply say that honey contains a small amount of prebiotics (as do many other foods).
- Prebiotics enter the colon where they nourish beneficial bacteria. The beneficial bacteria, typically within the hundreds of strains under the Lactobacillus and Bifidobacter families, create many health benefits through their action in the colon.

Probiotics are supplements that contain living organisms: bacteria. They typically contain anywhere from one to a few strains. Once consumed and in your system, the bacteria are just "bacteria" not "probiotics." However, for simplicity's sake, we will occasionally refer to the bacteria themselves as probiotic. Prebiotic Fiber is not greatly affected by heat, cold, acid or time. Probiotics can be killed by heat, acid or simply the passage of time. Prebiotics benefit from their simplicity. They are, simply, very special fibers that nourish the good bacteria. Because of this, they are pretty impervious to damage. Heat does not greatly harm them. They don't "die" just from the passage of time. Acid does not harm or degrade them. Probiotics by contrast are living organisms. If they are dead when they reach your colon, they cannot provide any health benefit. Probiotics must not be subjected to excessive heat during transport and warehousing. They should typically be refrigerated to ensure the bacteria remain relatively dormant and don't die simply from "old age". And the bacteria can be killed by

acid, such as found in the human stomach. Prebiotics nourish the thousands of good bacterial species already living in the colon. Probiotics contain from one to a few species of bacteria which are added to the colon. Your colon contains trillions (with a "T") of bacteria - more than all the 'human' cells in your body. More than all the stars in the milky way galaxy. It is a number possibly too big to really comprehend. In fact, it is likely that each person's colon "microbiota" is as unique as fingerprint. Prebiotics nourish all the good bacteria in the colon, particularly in the lacto- and bifido- families, preserving your "fingerprint". Probiotics typically contain a few, or even just one, strain of bacteria. These bacteria are typically from the same bifido- and or lacto- families, but may or may not match your particular microbiota.

- a. Prebiotic Fiber is a naturally-occurring substance. Probiotics occur naturally in fermented foods like yogurt or sauerkraut. Some companies have also engineered "proprietary" bacteria which they have patented and promote in their probiotic supplements/foods.
- b. Both prebiotics and the bacteria in probiotics are naturally-occurring substances. Prebiotics have been identified in over 36,000 plant species. The good bacteria contained in probiotic supplements naturally occur in fermented foods such as Kefir and Sauerkraut (though they are almost certainly destroyed if those foods are pasteurized.)
- c. Additionally, some companies have now both trademarked and patented their "own" bacteria. Trademarked bacteria are naturally occurring strains not "owned" by the company, but they have given them a 'consumer friendly' name which that company uses instead of the actual scientific name. So if you see a product that says it has "Defensis Maximus" bacteria... It's likely just a strain of Lactobacillus with a fancy name.
- d. Patented bacteria are actually engineered by a company from naturally occurring bacteria. Because they are now a "proprietary" strain, that company can then patent and "own" that strain of bacteria.
- e. Prebiotics foster an environment in the colon which is hostile to bad bacteria. Probiotics may impact bad bacteria by crowding them out.
- f. Prebiotics create an important secondary impact in the colon. By nourishing the good bacteria, they induce these bacteria to create Short-Chain-Fatty-Acids. These SCFAs slightly lower the pH of the colon, creating an environment that is friendly to good bacteria, but inhospitable to bad bacteria.

Probiotics may also achieve this by crowding out 'bad' bacteria, but may also suffer from 'drop in the bucket' scenario: while "X Billion" may sound like a lot of bacteria, adding them to "X Trillion" of existing bacteria likely means an addition of 0.1% or less. If they all survive! Probiotics and the Prevention of Colon Cancer. What did Pope John II, Audrey Hepburn, Ronald Reagan and Tony

Snow have in common. They all had colon cancer. Colorectal cancer (CRC) is the third most frequent cancer in men and women. Mortality from CRC is second only to that from lung cancer in men and breast cancer in women. Unfortunately it has shown no sign of decreasing during the past 20-30 years (1).

## 2. Probiotics and Prebiotics

### The creation of a synbiotic relationship

The evidence that our intestinal bacteria or microflora is important to our overall health continues to mount. I would like to present some information about the benefits of probiotics and prebiotics in preventing colon cancer. Before going further, I would like to define a couple of terms. You are already familiar with probiotics, but the term prebiotics may be less well known. Prebiotics are non-digestible starches found in certain fruits, vegetables and cereals. They are beneficial because they stimulate the growth of bifidobacteria and lactobacillus, both good bacteria. These two bacteria are able to digest or ferment prebiotic starches to produce short chain fatty acids (SCFAs). In experimental studies, the SCFAs enhance the function of the colon lining cells and have been helpful in the prevention of colon cancer. When a probiotic is combined with a prebiotic, for example in a capsule, it is known as a synbiotic. During the last 10 years, there has been a considerable amount of interest in how intestinal bacteria and diet can possibly alter the risk of colon cancer (2). Evidence from a wide range of sources supports the view that an individual's colonic microflora and diet are both involved in the development of colon cancer. Western diets high in animal products including fat, cholesterol and protein have demonstrated carcinogenic properties in experimental animal studies (3). In the 1970s, it was noted that colon cancer risk increased among descendents of persons in low-risk populations after moving to developed countries and converting to a Western diet (3). The composition of an individual's diet influences the predominant type of intestinal bacteria. The breakdown products of meat and fat that enter the colon can stimulate harmful intestinal bacteria to produce chemicals that pose a risk to the development of cancer (3). A study published in 1997 indicated how important the intestinal bacteria and diet are in the development of colon cancer. When germ-free animals were exposed to known colon carcinogens, only 20% developed chemically induced colon cancer. But when the same animals with normal intestinal bacteria were exposed to the carcinogen, 93% developed colon tumors (5).

The mechanisms by which probiotics may inhibit colon cancer are beginning to be understood. In an experimental animal study:

- Bifidobacteria inhibited the harmful bacteria from making enzymes that produced carcinogens derived from bile acids and residue of ingested meat (4).
- Probiotics altered the pH or acid level in the colon, which reduces the growth potential of harmful bacteria.

- Probiotics stimulated the intestinal immune system to destroy abnormal colon cells with altered DNA or chromosomes (4).

Prebiotic studies have discovered that by increasing the amount of prebiotics called fructooligosaccharides (FOS) in the diet increased intestinal levels of bifidobacteria. In turn, this produced more of the SCFA, called butyrate. Experimental studies have found that butyrate reduces chemically induced colon cancer in animal studies.

Published research indicates the following about butyrate:

- Has anti-carcinogenic properties, inhibiting the growth and proliferation of tumor cell lines
- Induces differentiation of tumor cells, producing a cell type similar to that of the normal mature cell
- Induces apoptosis or programmed cell death of human colorectal cancer cells (5). The combination of a pro- and a prebiotic has a synergistic effect, greater than that of either the pro- or prebiotic administered individually. Several studies of synbiotics have shown that the combination of a bifidobacteria strain and the prebiotic FOS was more successful at decreasing carcinogen induced cell damage (2,7).

The advances in the research into how intestinal bacteria and diet influence the risk for colon cancer are amazing. At this point there are no human clinical studies that have shown that probiotics and prebiotics prevent colon cancer, but the studies should encourage us all to eat a healthy diet containing fresh fruits, vegetables and high-fiber cereals. This diet enhances the healthy intestinal bacteria and lessens the production of potential colon carcinogens. Synbiotics like EndoMune may be beneficial in lessening the production of intestinal carcinogens. Stay tuned for further research news.

Many human diseases have found the healing touch in a balanced diet with necessary supplements. The prebiotics are dietary fibers that have found application in many such cases. However, the polysaccharides cannot be digested by the human beings under normal circumstances. Therefore, a combination of prebiotics with probiotics (called synbiotics) can be the best remedy. e.g., fibers containing dietary supplements are advised to patients with chronic constipation problems but emerging results prove that an inclusion of probiotics can alleviate the problem manifold as compared to the intake of fibres alone.

### Prebiotics Could Enrich the Probiotic Population

Although the human body lacks the polysaccharidases (the enzymes needed to digest the polysaccharides) to digest the prebiotics or the dietary fibers, when added to the nutritional regime of an individual have been found to cause sufficient health benefits. So, who can be reason behind their proper utilization? Studies have revealed that the microbes residing within the human gastro-intestinal linings have the necessary efficiency to degrade these saccharides. However, one major concern is that besides the beneficial microflora in the GI tract there is also pathogenic flora whose growth and proliferation rate needs to be curbed. A good prebiotic is one which will result in the

enrichment of the growth of the probiotics specifically. Inulin like polysaccharides, galactooligosaccharides, fructans and some other classes of carbohydrate food have been reported to act as probiotic enrichment media. According to the work of Ranadheera and his group, the nutrition is one of the determining factors for the regulation of microbial colonization of the GI tract. The study also suggests that the bacteria may be buffered by the food and its functional components through the extreme conditions of the stomach. There are also possibilities of potential interactions between the substrates and the microbes. Gibson and Sanders have shown that an increase in prebiotic diet helps maintaining a good and healthy microflora of the host gut. Natural prebiotics are an essential ingredient of many food products that enhances the functionality of the probiotics.

The contents of the food may be manipulated accordingly to increase the efficacy of the probiotics. e.g., prebiotics supplemented alongwith meat and diary products, beverages, cereals, baby food, etc to increase the efficacy of the beneficial bacteria. Many other food ingredients have been found to be effective for this purpose that includes whole parts and extracts of plants, microbial metabolites, fatty acids. Therefore, there is enough scope for the concomitant use of prebiotics and probiotics to exert a synergistic beneficial effect.

**Rationale behind the Selective Growth Promotion by Prebiotics:** The probiotics possess saccharidases that can break down the complex sugar molecules into absorbable and other beneficial forms. However, this ability is also existent among the non-beneficial pathogenic strains that crowd the human GI tract. The by-products of digestion of inulin-like polysaccharides result in the accumulation of short chain fatty acids among others. The SCFAs so produced can exert a large number of useful actions. But they can also reduce the pH of the environment drastically. At times it has been noticed that the pH has been reduced in the range of (2-3). Such an acidic condition inhibits the growth of most of the microorganisms including the pathogenic forms. In fact a significant part of the population is removed by this shift in pH.

A wide variety of probiotic strains from both *Lactobacillus* and *Bifidobacterium* genera have been isolated that can well tolerate such a hostile environment. Accordingly, in due course of time the beneficial probiotic strains can wipe out the pathogenic strains from the gastrointestinal tract due to this selectivity of the substrate provided. In recent times, a number of reports have come up in reputed international journals which prove that the use of prebiotics can make the gut colonization by the probiotics faster and efficient. In 2011, the World Gastroenterology Organization has set up the guidelines for the effective use of prebiotics and probiotics together.

### 3. Health Benefits of Using Synbiotics

Probiotics are already in use for the wide array of beneficial effects that they can produce particularly with respect to the diseased condition. The intake of fermented probiotic food

is very common in many parts of the world from ancient times. Among others the probiotics can alter the digestive system and the colonic microflora that can help to prevent cases of diarrhea and also the enhancement of the immune response. The dietary sugars consist of a large family of known and unknown compounds that results in specific health benefits such as in chronic constipation, diarrhea, etc. and has therefore raised interest among scientists, researchers and nutritionists. However, it is an established fact that merely overloading the diet with these carbohydrates alone cannot produce the required useful effects. Therefore, the need of the hour is to find out the right prebiotic-probiotic combination in dealing with the aforesaid problems. But before using these combinations with claims of diseased condition reduction and beneficial endpoint results, the claims must be well justified in human beings alongwith the mechanistic behind such beneficial traits.

The potential areas which the use of synbiotics can target include the alteration in the colonic microbiome content, changes in insulinemia, fatty acid metabolism modifications, improvements in the absorption and bioavailability of the dietary minerals like calcium, iron and zinc. The exerted negative influence on colon cancer is another area of potential future research. Besides, the breakdown of inulin like polysaccharides by the probiotics results in the synthesis of a number of low energy sugar molecules which can also be quite interesting from the point of food product development. In addition, the effects of prebiotic and probiotic might as well be synergistic or additive. Such evidences have come up in experiments to assess the combined role of inulin and bifidobacteria as anticancer agents.



Figure 3

Probiotics are the beneficial bacteria and other microbial organisms that naturally live in the digestive tract and female vagina of animals. Your own body is home to trillions of these “friendly” beneficial microorganisms.

#### Sources

Acacia Gums (Gum Arabic) are considered the richest natural source. Other traditional dietary sources of prebiotics include beans, inulin sources (such as Jerusalem artichoke, jicama, and chicory root), raw oats, unrefined



wheat, unrefined barley, and yacon. Some of the oligosaccharides that naturally occur in breast milk are believed to play an important role in the development of a healthy immune system in infants.[12]

While there is no broad consensus on an ideal daily serving of prebiotics, recommendations typically range from 4 to 8 grams (0.14–0.28 oz) for general digestive health support, to 15 grams (0.53 oz) or more for those with active digestive disorders. Given an average 6 grams (0.21 oz) serving, below are the amounts of prebiotic foods required to achieve a daily serving of prebiotic fiber:

**Table 1**

Raw Food Items [Veggies/ Fruits]	Prebiotic Fibre Content (w/w)
Acacia Gum	7 g (0.25 oz)
Raw Chicory Root	9.3 g (0.33 oz)
Raw Jerusalem Artichoke	19 g (0.67 oz)
Raw Dandelion Greens	24.7 g (0.87 oz)
Raw Garlic	34.3 g (1.21 oz)
Raw Leek	51.3 g (1.81 oz)
Raw Onion	69.8 g (2.46 oz)
Cooked Onion	120 g (4.2 oz)
Raw Asparagus	120 g (4.2 oz)
Raw Wheat Bran	120 g (4.2 oz)
Whole Wheat Flour, Cooked	125 g (4.4 oz)
Raw Banana	600 g (1.3 lb)
<i>Source [13]</i>	

Those wishing to ensure sufficient prebiotic intake should carefully consider the prebiotic content of their diet, as well as what caloric/nutritive load comes along with it: e.g., eating 600 grams (1.3 lb) of bananas daily is likely to provide an excess of calories and sugars/carbohydrates to the diet. Prebiotic fiber supplements with minimal caloric/fat/sugar load are also available.

**Chicory Root has the highest percentage of Prebiotic Fiber per gram:**

Prebiotic oligosaccharides are increasingly added to foods for their health benefits. Some oligosaccharides that are used in this manner are fructooligosaccharides(FOS), xylo oligosaccharides (XOS), polydextrose, and galactooligosaccharides (GOS). Moreover disaccharids like lactulose or some monosaccharides such astagatose are also used sometimes as prebiotics. Also in petfood, manno oligosaccharides are being used for prebiotic purposes. Genetically engineering plants for the production of inulins has also become more prevalent [14][15] despite the still limited insight into the immunological mechanisms activated by such food supplementation.[16]

Plain popcorn has already been hailed as a great diet food for its low calorie content but now a group of scientists claim it may even top fruits and vegetables in antioxidant levels. Antioxidants – known as polyphenols – have huge health benefits as they help fight harmful molecules that damage cells. Popcorn was found to have a high level of concentrated antioxidants because it is made up of just four percent water while they are more diluted in fruits and vegetables because they are made up of up to 90 percent water. Researchers discovered one serving of popcorn has up to 300mg of antioxidants – nearly double the 160mg for all fruits per serving. They also found that the crunchy hulls of the popcorn have the highest concentration of antioxidants and fiber. Air-popped popcorn has the lowest number of calories while microwave popcorn has twice as many calories as air-popped.



**Figure 4**

Phytosynbiotics are orally-administered natural formulations of synergistic prebiotic and probiotic cofermented with plants to amplify their special properties. The health benefits of probiotics have also been amply documented in scientific journals. Probiotics are friendly, living micro-organisms which are important for the maintenance of gut health and the better uptake of nutrients by the gut. To view the effects of phytosynbiotics on specific conditions, click the tabs above.

**4. Fermentation**

Fermentation is one of the oldest method of food preparation and preservation technique used throughout the world. The health benefits and medical advantages of consuming fermented food are well documented. However traditional fermentation is an inconsistent process - more an art than a science - which makes it difficult to use fermented food for therapeutic uses. We have addressed the disadvantages of traditional fermentation, and through many years of research, developed our own proprietary fermentation processes to standardise and systematically amplify the benefits of fermentation in a consistent and repeatable manner. Under strictly controlled fermentation processes, beneficial microorganisms transform raw materials of plant source, breaking down sugars, carbohydrates and proteins into a phytosynbiotic product brimming with many beneficial properties. Fermentation

brings about beneficial results because it brings about a series of biochemical transformations:

- a. Unlocking of nutrients and vitamins from raw plants, eg hydrolysis of starch into shorter chains of glucose and dextrose, increasing levels of vitamins particularly thiamine, nicotinic acid, biotin and riboflavin.
- b. Reduction of naturally occurring toxins in the plants thus rendering them safe for consumption.
- c. Production of enzymes that aid in increasing the bio-availability of the nutrients so that our bodies can absorb and assimilate them more easily.
- d. Presence of probiotics and prebiotics to support a healthy gut microbiota and maintain proper digestion function (see below sections on probiotics and prebiotics). When digestion is functioning properly and the body is absorbing and assimilating all the nutrients needed, the immune system tends to be better equipped to wage war against disease and illness.

#### **An overall outlook about Synbiotics (Pre & Probiotics)**

Lactobacilli are very important for gut health. Scientific research has shown that Lactobacilli help in the following manner:

- a. Lactobacilli secrete bacteriocins that kill the harmful bacteria like *E. coli* and *Clostridium*;
- b. Lactobacilli signal to immune cells of the gut to intensify its defense against harmful bacteria and even some viruses. This, in turn, prevents the epithelial lining of the gut from being attacked by these harmful bacteria and viruses.
- c. Our phytosynbiotic products contain a broad spectrum of Lactobacilli and this ensures that the appropriate types in adequate amounts are made available in the gut for people of different age groups.

Prebiotics are natural components of common food such as beans, fruits and vegetables. The well known ones are inulin and fructo-oligosaccharides. Human breast milk contains a high amount of prebiotics that are needed by growing infants to build strong immunity systems. In our phytosynbiotic products, the prebiotics are produced from naturally fermented plants. Scientific research has shown that prebiotics help in the following manner:

Prebiotics stimulate the immune cells in the gut to produce anti-inflammatory factors that quell onset of food allergies.

- a. Prebiotics stimulate the growth of *Bifidobacterium* which helps to eliminate harmful bacteria, e.g. *E. coli* and *Clostridium*, in the gut.
- b. Prebiotics strengthen the epithelial lining of the gut and maintain its integrity by producing a compound called SCFA which is an important nutrient for the epithelial lining of the gut.
- c. Prebiotics protect the probiotics in the formulation, so that they can survive the harsh environment of the acidity of the stomach and the bile salts of the proximal end of the small intestine.
- d. The survivability of the probiotics is very important for the proper colonization of the lower parts of the gut to exert their beneficial effects.

#### **Synergistic Effects in Phytosynbiotics**

Both prebiotics and Lactobacilli work synergistically to strengthen the epithelial lining of the gut and to maintain its integrity. A strong and intact gut lining ensures better absorption of nutrients and bioactive compounds, while preventing harmful by-products from invading the body. A strong and intact gut lining also reduces digestive problems like diarrhea, constipation and flatulence, common in people who have metabolic imbalance. Our proprietary phytosynbiotic method of manufacture ensures that the Lactobacilli are not inactivated by the natural bacteriocins released by the fermenting plants and at the same time, the bioactive compounds of the plants stay activated throughout the process. This method of manufacture micro-encapsulates the Lactobacilli and the bioactive compounds within a natural oligosaccharide matrix. As a result, our phytosynbiotics among the first brands of nutraceuticals produced using the most effective combination of prebiotics, probiotics and plants. The phytosynbiotics are manufactured in a pharmaceutical GMP-grade facility to ensure that the product is of the highest quality.

#### **5. Conclusion**

Prebiotics are the lesser-known sibling of probiotics. That is to say, prebiotics are the indigestible dietary fibers we get from food that probiotics use to flourish and grow. Whereas probiotics are living organisms, prebiotics are not. Prebiotics can help the bacteria that is naturally found in your intestines flourish. Some prebiotics you may have heard of include oligosaccharide and inulin, which is naturally found in the chicory root. Some other foods that we eat a tad more regularly that contain prebiotics are onions, leeks, whole grains and bananas. These fibers are indigestible, meaning they make their way to our digestive tract intact, feeding probiotic bacteria and keeping our intestines healthy places, filled with good bacteria. Over the years, there has been more encouraging evidence that probiotics and prebiotics can help maintain a healthy digestive balance. There have been studies that suggest that these supplements can reduce the severity of a cold or the flu and can lessen the likelihood of developing certain cancers. Some doctors (particularly naturopathic ones) may suggest taking probiotic and prebiotic supplements on a regular basis if you've had recurrent yeast infections or suffer from irritable bowel syndrome. Because probiotics feed off of prebiotics, the two supplements generally go hand in hand, though some probiotic supplements also contain prebiotics - thus they are called synbiotics, because these probiotics and prebiotics are essentially working together. Probiotics live naturally in everyone's digestive system. Some of these friendly bacteria can also be found in yogurt or supplements. Our digestive system performs a constant "balancing act" between probiotics and unhealthy bacteria. Probiotics help to keep the number of unhealthy bacteria in check. When the levels of the different kinds of bacteria are balanced, the body functions better. However, stress, poor diet and certain medications can disrupt this balance, allowing bad bacteria to multiply. There is a growing consensus that the intestinal flora is closely related to the host's health and proneness to disease. The

predominance of harmful bacteria in the intestine may ultimately lead to various disorders, while useful bacteria subsequently act as scavengers and physiological regulation in the large intestine. Prebiotics and probiotics are obviously interesting agents in the field of preventive nutrition, and they should therefore have an important development. Combining probiotics with prebiotics could improve the survival of the bacteria crossing the upper part of the gastrointestinal tract, thus enhancing their effects in the large bowel. Moreover probiotic and prebiotic effects might be additive or even synergistic.

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