

Leaky Gut Syndrome (LGS)

Origins, Effects and Therapies

The “Medical Link” Between Dysbiosis and Many Major Ailments

“Is This the Most Misdiagnosed/Underdiagnosed Condition in Medicine Today?”

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DEFINITION – LEAKY GUT SYNDROME

A progressive and accumulative microtrauma to the gastric mucosa, compromising gut cellular integrity, inducing increased gut wall permeability with subsequent penetration of partially digested protein macromolecules and other microorganisms through gut/blood barrier into systemic circulation.¹

In other words, **Leaky Gut Syndrome is an inability of the gastric lining to keep undigested food or potentially pathogenic organisms from absorbing into the blood stream.** Abnormally large spaces develop between the cell walls of the gut, allowing unwanted material to pass through. The gut becomes “leaky” in the sense that bacteria, parasites, viruses, fungi and their metabolic byproducts, undigested protein, fat and waste pass through a hyperpermeable, porous or “leaky” intestinal wall and are absorbed into the bloodstream. This leads to a blood antibody reaction involving IgG4 defense cells. The invading proteins form new cells, called ‘Circulating Immune Complexes’ or CIC’s.¹⁰ These cell complexes, neutralized in a healthy person, are responsible for type I and type II delayed food allergies. Individuals with Leaky Gut Syndrome experience a gradual accumulation of these CIC’s, eventually reaching an intolerable level within the circulation. When the system becomes saturated with CIC’s, the **blood deposits these cells in soft tissues and joints throughout the body.**¹ **Local inflammations occur at the deposit sites** of CIC’s, resulting in pain and swelling.¹ The deposit sites often correspond to the eighteen (18) fibromyalgia tender points (16 have external pressure points), in addition to various joints in the body.^{1,133} This is just a part of the far reaching disease we call Leaky Gut Syndrome.

Leaky Gut Syndrome was once a controversial diagnosis in mainstream medicine. Today, knowledge of the processes leading to the condition and our ability to reverse the harmful effects make Leaky Gut Syndrome a very treatable and preventable disease. It is hypothesized that Leaky Gut Syndrome may be a precursor to many of the common diseases of lifestyle and exposure affecting man today. **By simple prevention and nutritional therapy, Leaky Gut Syndrome can be repaired,** greatly enhancing proper digestion. This in turn elevates our immune function and improves the overall health of the patient, regardless of underlying conditions that may exist.



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ANATOMY AND PHYSIOLOGY OF THE GI TRACT

Mouth

The digestive process begins when the brain initiates a need for caloric intake. It sends signals to the body to prepare for stomach acid release and create more saliva. After ingestion of food, digestion continues in the mouth with thorough chewing (mastication). This is very important and the **degree of mastication will ultimately predict the quality of digestion**.⁸ Each bite of food should be chewed no fewer than ten times before swallowing. Chewing greatly reduces the work of the stomach by increasing the surface area of the foods we eat allowing greater activity of acid and enzymes to thoroughly unlock available nutrients. Saliva contains salivary amylase, an enzyme that initiates digestion of carbohydrates.¹⁰ The mass of chewed food and saliva passes through the esophagus and into the stomach.

Stomach

The anticipation of food, or “Pavlovian response,” initiates a secretion of hydrochloric acid from the parietal cells surrounding the stomach lining and pepsin from the mucosal layer in the stomach. This is where protein digestion begins.⁵² Once in the stomach, the mixture of digestive enzymes, acid, bacteria, and food is further broken down into its basic components. The stomach is a very muscular organ, which churns the mixture, greatly aiding the digestive process with increased exposure to the “essential degradators”. If any of these factors is missing or depleted, digestion is compromised.^{31,10}

After HCL, enzymes and microorganisms in the stomach continue digestion, this slurry now called chyme is ready to pass into the duodenum. The length of time chyme remains in the stomach is dependent upon its contents. One source states an average of **fifteen to forty-five minutes**,¹⁰ without qualifying or defining contents. Certain types of protein can greatly lengthen the time chyme remains in the stomach. For example, other sources state twelve ounces of **beef may remain in the stomach for as long as three or more hours** depending on the digestion efficiency/level of HCL.^{70,79,80}

Small Intestine

Prior to stomach contents passing into the beginning of the small intestine known as the duodenum, the pancreas has secreted digestive enzymes and bicarbonates creating an alkaline environment.³¹ The pH of the duodenum **must be alkaline or no further significant digestion can occur**.^{10,13,31,73,74} The next level of digestion occurs in the small intestine, which has three regions with the following primary functions:

- **Duodenum**, eight to twelve inches long and responsible for the absorption of minerals and neutralizing the very acidic stomach contents, with secretions of bicarbonates from the pancreas.^{10,31} In the duodenum, the combination of digestive enzymes, bile and bile acids, and bacteria continue the further degradation of whole food into usable nutrients. Each will be discussed in detail, as their influence on Leaky Gut Syndrome is profound.¹¹
- The middle region, known as the **jejunum**, has an average length of eight feet.^{10,31} The jejunum is responsible for absorption of water soluble vitamins, carbohydrates and amino acids.
- The bottom third of the small intestine, the **ileum**, averages approximately twelve feet.^{10,31} Absorption of fat soluble vitamins, fat, bile and cholesterol salts occurs in the ileum.^{10,31} From here, the semi-solid, mostly waste products pass into the large intestine.

Large Intestine

The large intestine is **principally responsible for absorption of water into the circulatory system** from the waste laden stool. Small amounts of nutrients are extracted from the indigestible final mass that will be excreted from the body. This final stool releases many byproducts of digestion, which can be toxic to the body if stored for too long. The large intestine is also a **rich source of bacteria helping regulate proper fluid balance** and elimination.^{5,11}



DIGESTIVE ENZYMES

Along with their obvious catabolic function, digestive enzymes share responsibility for **keeping the small intestine free of harmful bacteria, yeast, protozoa, and intestinal parasites** and help the body break down immune complexes.^{10,13,31,73,74}

The body has over 3,000 different enzymes that are used in the proper function of every bodily process. Scientists are expecting to identify many more.⁷³ Twenty-two different enzymes have been identified specifically for the digestion of proteins, carbohydrates, fats and fiber.^{10,13,31,73,74}

The enzymes that are produced by the pancreas are actually secreted into the duodenum as inactive pro-enzymes. Once in the duodenum, these pro-enzymes are activated by enteropeptidase, which is continually secreted by healthy cells lining the small intestine. In patients with a duodenal ulcer, inflammation or severe Leaky Gut Syndrome, this **secretion of enteropeptidase can become compromised thus leading to deficient enzyme activation** which results in reduced digestive ability.^{227,228,229,230} These enzymes must be activated to perform their function. Some of the most important digestive enzymes include:

Amylases

Amylases are responsible for primary carbohydrate digestion. Carbohydrates range from simple (very little digestion needed before absorption takes place) to complex carbohydrates which are broken down by amylase into maltose. Then the enzyme maltase breaks down maltose into glucose where it is then absorbed into the blood stream. Milk sugar, known as lactose, is digested by lactase into its usable form. Sucrose (commonly known as table sugar) is quickly broken down by disaccharidase (sucrase) and absorbed as glucose.^{224,230} Deficiencies in amylases are associated with skin conditions (**hives, rashes, eczema, psoriasis**), **the herpes virus and diseases of the body including bronchitis and other upper respiratory disorders, chronic diarrhea, dizziness, environmental contaminant exposure, hyperactivity, insomnia, mood swings and seizures.**^{10,13,31,73,74} Additionally, deficient individuals may experience bee sting/insect bite allergies, muscle and joint pain.

Proteases

Trypsin, chymotrypsin, peptidases, elastases, and cathepsin form the PROTEASE group.⁷³ Proteases cleave the very large and highly nitrogenous proteins into smaller usable amino acids. These amino acids, 20 of them in particular, are essential for proper growth and maintenance of the body. Protease deficiency has been linked to **suppressed immunity, anxiety, cold hands/feet, water retention, swelling in ankles, frequent bacteria/viral infections, leaky gut/irritable bowel syndrome, and related syndromes, kidney disease, bone degeneration, osteoporosis, decreased prothrombin time and hypoglycemia.**^{10,13,31,73,74,224,230}

Lipases

Lipases act on the emulsified fats that have been processed by the bile and bile acids. Lipase will cleave the fats into easily absorbable molecules that will be primarily absorbed through the gastric mucosa into the lymphatic and then the circulatory systems. This process begins when the bile initiates emulsification, which is followed by further digestion by the lipases. Lipase deficiencies are associated with **cardiovascular diseases, diabetes, hypertension, high cholesterol, obesity, dizziness and difficulty losing weight.**^{10,13,31,73,74}

Cellulase

Cellulase is responsible for digestion of fiber. Because our body does not produce cellulase, this enzyme must be acquired from our diet. **Only raw foods contain cellulase.** Deficiency is associated with **acute food allergies, candidiasis, diverticulitis, chronic fatigue, sinus infections, irritable bowel, gas and bloating.**^{10,13,31,73,74}

Bile & Bile Acids

As chyme enters the duodenum, the gallbladder releases bile for further fat digestion.^{10,13,31,73,74} Most of this digestion is due to emulsification of fats and working as a vehicle for fat absorption. Bile and bile salts convert fats into a semi-water soluble mix that is more easily absorbed.

Hormone Regulators

A fascinating feature of the digestive system is it contains its own regulators. The major hormones that control the functions of the digestive system are produced and released into the blood of the digestive tract and travel back to the digestive system, where they stimulate the digestive function and cause organ movement. The hormones that control digestion are gastrin, secretin, and cholecystokinin (CCK).^{224,228,230}

- **Gastrin** causes the stomach to produce an acid for dissolving and digesting some foods. It is also necessary for the normal growth of the lining of the stomach, small intestine, and colon.
- **Secretin** causes the pancreas to produce bicarbonate and stimulates the liver to produce bile.
- **CCK** causes the pancreas to grow and to produce the enzymes of pancreatic juice, and it causes the gallbladder to empty.

Bacteria

The importance of bacteria in digestion cannot be overemphasized. Much of our diets today are not comprised of raw foods. **The Standard American Diet (SAD) fills our bodies with preservatives, pesticides, man made chemicals, and other semi-indigestible matter.** Between our digestive enzyme system and the ultimate chemical processor (the liver), our systems are being overworked to a point of ill health. Beneficial bacteria in our digestive tract **help break down and detoxify many of these chemicals,** assist in normal digestion, and help protect our digestive tract lining from parasites and other pathogenic invaders.^{25,30,123,163,173} A full description of the benefits of beneficial bacteria (probiotics) can be found in issue 17 of The Herbal Pharm.

ETIOLOGY

Now that the anatomy and physiology is understood, we need to look at causative relationships and agents. Many of the factors causing Leaky Gut Syndrome work on more than one mechanism, thus not only affecting the anatomical structure of the gut lining but also the physiologic. The combination causes a cycle of destruction to the gut lining which inhibits a healthy physiological response of the gut. The major causes of Leaky Gut Syndrome are listed with specific agents listed in subsections.

HYPOCHLORHYDRIA

Hypochlorhydria is a deficiency in gastric acidity. This is a major cause of Leaky Gut Syndrome. The stomach is an acidic environment. It is designed that way by nature and anything that causes a decrease in this acidity can be deemed a negative influence on intestinal health. Acidity is imperative for proper digestion, protection against pathogens, gastric emptying time, assimilation of pro-vitamins and medications, and acid–base balance. A state of hypochlorhydria in the stomach not only influences the digestive procedure for the rest of the GI Tract, but also many systems in the body. Poorly digested food and pathogens pass into the small intestines where they **may be absorbed and affect the rest of the body both toxically and allergenically.**^{10,13,73,74}



SYMPTOMS OF HYPOCHLORHYDRIA:^{10,13,31,57,73,74}

- Bloating
- Belching
- Burning
- Flatulence immediately following meals
- Indigestion
- Diarrhea
- Constipation
- Itching around the anus
- Multiple food allergies
- Brittle fingernails
- Dilated blood vessels on cheeks and nose
- Acne and/or other dermatological manifestations
- Iron deficiency
- Parasites or abnormal flora of intestines
- Candida albicans proliferation
- Nausea after taking nutritional supplements

Hypochlorhydria also has a major impact on the other Leaky Gut Syndrome factors including dysbiosis, allergies, irritation, and nutrition.^{10,13,11} Hypochlorhydria is found in many different disease states and can aggravate the disease causing the reduced acid. The following disease states are either a result of and/or result in Hypochlorhydria:

CONDITIONS ASSOCIATED WITH HYPOCHLORHYDRIA:^{10,13,31,57,73,74}

- Addison's disease
- Asthma
- Coeliac disease
- Dermatitis herpetiformis
- Diabetes mellitus
- Eczema
- Gallbladder disease
- Rheumatoid arthritis
- Rosacea
- Sjogren's syndrome
- Thyrotoxicosis
- Grave's disease
- Hepatitis
- Chronic hives
- Lupus erythematosus
- Myasthenia gravis
- Osteoporosis
- Pernicious anemia
- Psoriasis
- Hyperthyroidism
- Hyperthyroidism
- Vitiligo

MEDICATIONS/DIETARY CONDITIONS THAT CAUSE HYPOCHLORHYDRIA:

- **Antacids** - Directly neutralize existing stomach acid by chemical reaction. Antacids inducing hypochlorhydria **bind with phosphate in the gut, causing malabsorption that potentially leads to osteomalacia,**²⁰ a precursor to osteoporosis. Antacids also predispose the body to Leaky Gut Syndrome through a secondary channel – nutrient depletion.^{19,20} Nutrient depletion occurs due to poor assimilation or direct binding of essential nutrients in the increased pH of the gut. This is also a “chicken or the egg” relationship as these nutrients are imperative for proper function and maintenance of the gut wall. Due to the complexities of this topic, the significant depletions and their potential effects in each category will be discussed in a future issue.
- **Anti-ulcer medications** – This class of drugs includes the H2 antagonists and the proton ion pump inhibitors. Now available as over the counter drugs, these medications can upset proper pH levels. These medications can lead to achlorhydria - a condition of no acid production. They can also be very long acting. With this in mind, **food that enters a stomach with no acid will sit for hours and putrefy rather than digest.**^{18,19,20,91}
- **Excess carbohydrates** – This is a common problem due to the exceptionally poor, high sugar diets that afflict so many Americans today. Digestion of large amounts of simple sugars release large amounts of basic (high pH) byproducts. This can cause **neutralization of stomach acid leading to Hypochlorhydria.** Also of note, the alkaline, sugary, warm environment is perfect for the growth of yeast - specifically candida.^{5,31,54}

DYSBIOSIS

The word itself literally means “dys”: incorrect, “biosis”: life. Dysbiosis is the epitome of incorrect life in the body. Trillions of bacteria inhabit our bodies. Many of these bacteria have a healthy symbiotic relationship with the host. However, this fragile eco-system is under constant attack by outside forces. This delicate balance can easily become pathogenic and thus is a main cause of Leaky Gut Syndrome.^{21,120,123}

In our discussion of hypochlorhydria, we saw that **a direct correlation exists between proper pH and proper bacterial growth**. In this section, we will look at items that directly affect bacterial growth. As stated previously, a dysbiotic situation has multiple effects on the body. Dysbiosis leads to a further acid reduction in the stomach due to a contamination in the proper biochemistry of the system. Think of it this way: Your car runs well on good gasoline and proper air intake. Cut down the air supply and you have a poorly functioning vehicle that will build up significant impurities of improper combustion. Your body will do the same thing if not given the proper bacteria and nutrients. Dysbiosis leads to an increased risk of pathogenic bacteria overwhelming the intestines. This ultimately compromises the immune system since these beneficial bacteria secrete huge portions of the substances that work as part of our immune system.^{120,123} For more information on Dysbiosis, refer to issue 17 of the Herbal Pharm™. The following are the main direct factors leading to Dysbiosis:

- **Antibiotics** – Even though the correlation is obvious, antibiotic therapy is a main cause of Dysbiosis. Antibiotics are not selective in their eradication of bacteria. After antibiotic therapy, it is literally a roll of the dice in determining which organisms return to recolonize the body. In our antibiotic crazy society, we are developing bigger and better pathogenic organisms due to antibiotic resistance from overuse. After each regimen of antibiotics a person takes, **the risk grows ever larger that a dysbiotic environment will result**. Antibiotics contribute to dysbiosis when taken as prescribed medication.^{25,26,28,30} Also, to a minor degree, antibiotics are consumed through animal protein since they are given to most commercially raised animals. These antibiotics are often very ‘broad spectrum’ and kill off a wide range of good bacteria. Even though the amounts of these transferred antibiotics may be small, the sensitivities still exist.⁴⁵
- **Pesticides & Insecticides** - Like antibiotics, these chemicals are not highly specific in what they kill. Once in our system, they can continue to kill which makes them a major player in dysbiosis. Overuse in today’s farming serves to fuel this fire. The use of these products began in the 1930’s and has spread globally ever since. Products like DDT were first used in World War II as a delousing agent. Its use skyrocketed after the end of the war and it wasn’t until decades later that it was banned in the U.S. because of its toxic and even lethal long term effects in certain species, including man.^{19,63,66,67} Unfortunately, this ban does not extend to foreign countries where much of our seasonal produce is grown. **It is unclear whether foreign growers are in compliance with the DDT ban.**¹³³

Certain fruits actually absorb chemicals placed on them during their development and thus cannot be washed off.¹⁷ For example, strawberries.¹⁷ A major problem with today’s pesticides/insecticides is that they are comprised of highly complex large organic molecules that are difficult for the body to process. This translates into a dilemma for the liver and the body’s defense mechanism is to store these chemicals in fat cells. Much is still unknown about the long-range effects of today’s new toxins. **Thorough washing with a mild soap and water is a must for all produce.** Organic fruits and vegetables are now widely available and a good recommendation.

- **Parasitic infection** - Parasites abound everywhere we live. Our exposure to them on a daily basis is unavoidable. Parasites that effect humans most commonly are amoebas, giardia, trichina, cryptosporidium, and the various worms known as helminths. Parasitic infection is more commonly a byproduct of the many causes of Leaky Gut Syndrome. These parasites are opportunistic. In other words, they most commonly infect people with reduced defenses. As we have learned, Leaky Gut Syndrome is caused by and potentiated by a weakening of our most primary defenses - highly acidic stomach, healthy intestinal lining, a proper balance of beneficial bacteria and a strong unhindered immune system. When these defenses are compromised, parasitic invasion is not only possible but



also probable. Leaky Gut Syndrome not only opens the doors for parasites but is also potentiated once this invasion occurs. Parasitic infections can smolder in the body for years or even decades undetected, causing very uncomfortable and pathogenic effects and illnesses.^{5,10,36,133}

COMMON CAUSES OF PARASITIC INFECTION³⁶

- Ingestion of improperly cooked meat or fish.
- Food handlers in restaurants.
- Water - Giardia lamblia and Cryptosporidium.
- Pets - Direct kissing of pets, a leading cause of spreading parasites to humans.
- Foreign travel.

SYMPTOMS OF PARASITIC INFESTATION^{28,88,133}

- Constipation
 - Diarrhea
 - Flatulence and anal itching
 - Bloating
 - Irritable bowel syndrome
 - Joint and muscle aches
 - Allergies
 - Anemia
 - Skin conditions (in many categories)
 - Sleep disturbances
 - Chronic fatigue
 - Immune dysfunction
- **Heavy metal toxicity** - Heavy metal toxicity is a major contributor to dysbiosis. It is often overlooked and ignored by the majority of medical providers unless a patient shows signs of lead or other obvious metal poisoning. The most common heavy metals responsible for toxicity are lead, cadmium, mercury, and aluminum.^{1,10,133,134} The essential elements of iron and manganese have also been implicated in toxicity issues.¹⁰

Soil, air, residential/commercial building materials, numerous cleaning products, pesticides, insecticides, foreign produce, processed foods (particularly evaporated milk saturated with cadmium), fungicides, fertilizers, soft drinks from vending machines with cadmium piping, and industrial fumes are major sources of heavy metals. This list is only scratching the surface as contamination of our environment continues to grow.^{1,10,133,134}

SIGNS AND SYMPTOMS

All **heavy metal and petrochemical toxicities will induce various levels of dysbiosis.** In addition, both heavy metal and petrochemical toxicity will **produce brain damage over time.** By the time significant symptomatology manifests, the toxicity has been present for an extended time in most cases unless there has been an accidental spill or sudden release of toxic fumes or similar incident.

- **Candidiasis** - Candida is an opportunistic fungus (yeast) that will populate virtually any area of the human body if given the chance. As mentioned previously, a **low acid, high carbohydrate environment is very conducive to candida proliferation.** Dysbiosis and subsequent LGS provide an ideal breeding ground for Candida and set the stage for overgrowth (Candidiasis). Candida can cause:^{13,28,30,123}
 - Athlete's foot
 - Fungus under nails
 - Chronic ear infections, sinusitis, bronchitis
 - Hair loss
 - Ridges on nails
 - Indigestion/heartburn
 - Dark circles under eyes
 - Multiple horizontal lines under eyes
 - Eczema
 - Bad breath
 - Foul smelling feces
 - Flatulence
 - Fungus growth behind the ears
 - General confusion
 - Itchy scalp
 - Tingling in extremities
 - Fatigue
 - Chronic coated tongue

WOMEN ONLY:

- PMS
- Sore breasts
- Increased pain during menstruation
- Propensity to yeast infections

As candidiasis becomes chronic, it changes from a benign form to an invasive fungal form that appears to permeate the intestinal mucosa.^{10,28,31} This weakens the gut membrane, increasing permeability and contributing to Leaky Gut Syndrome.^{10,28,31} Candidiasis and Leaky Gut Syndrome are often prerequisites of each other and are advanced stages of long term disease left untreated and unprevented.

ALLERGENS

- **Food allergies** - Food allergies can be divided into two distinct categories when it comes to LGS. The first is a beneficial reaction that is necessary for proper gut function and protection. Release of salivary secretory IgA is initiated by a normal allergic type reaction to ingested food. This mild allergic reaction stimulates release of IgA from the gallbladder, which protects the mucosal lining of the intestines. When improperly digested food from a hypochlorhydrial state in the stomach is released into the duodenum, undue stress is placed on IgA to protect the intestinal lining. This defensive mechanism becomes exhausted and IgA levels begin to fall. Food allergens then make direct contact with protective mast cells, which also line the gastric mucosa. Food allergens contacting the inner layer of cells of the intestinal lining irritate mast cells which release chemical mediators, inducing further gut weakening and inflammation.^{10,31,52} These mediators include: Bradykinin, inflammatory prostaglandins, heparin, serotonin, histamine and leukotrienes.¹⁰ The repetitive reactions of releasing chemical mediators represents a form of micro-trauma to the gastric mucosa which produces weakness in the gastric mucosa, increasing the permeability.^{10,31} This leads to the negative category of food allergy in LGS. With the increased permeability, larger - than - acceptable food particles enter the blood stream setting off the allergic reaction as discussed in the definition of LGS found in the beginning of this issue.
- **Food additives** - Additives in our processed foods today have become such an overwhelming obstacle to good nutrition that no disease state remains unaffected. Preservatives, colors, flavors, enhancers, free flow agents, fillers, stabilizers, emulcents, thickeners, foam preventers, etc. are hurdles that the digestive tract, liver, kidneys, and immune system have to clear. The latest so-called advances are the non-digestible fats. These additives and the “dead” foods in which they are found have **strong allergenic tendencies, are nutritionally void, and compromise good bacterial growth.**^{11,14,62,82,87}

DIRECT IRRITANTS

- **Excessive alcohol** - Alcohol's irritating ability is well documented. If you have your doubts, have a shot of strong whiskey and feel the burning sensation right down into your stomach. Alcohol consumption **directly contributes to hypochlorhydria** by interfering with hormonal neurotransmitters that stimulate acid production and release.^{34,35,37} Alcohol suppresses delta-6-desaturase (EFA's) to protective prostaglandins (PG's.) The lack of PG's contributes to increased gut permeability^{10,34,35,37} which also promotes candida proliferation.^{10,28,30}

Typically, alcohol is bacteriocidal. This antibacterial action includes beneficial bacteria. **In treating LGS, alcohol is absolutely contraindicated until the gut's integrity can be restored.**

- **Non-Steroidal Anti-Inflammatory Drugs (NSAID's)** - NSAID's are the second largest group of drugs, behind antibiotics, to cause and/or aggravate LGS. NSAID's, even though they are labeled “anti-inflammatory”, cause inflammation of the gut lining which increases the permeability. This is



achieved by **suppressing and eventually destroying delta-6 desaturase**, thus preventing conversion of EFA's to PG's. This loss of the lining protective PG's opens the avenue for direct assault on the gut epithelium. Misoprostol, a PG analog, can be used as a pre-therapy preventative but will not reduce pre-existing inflammation.²³³

Certain NSAID's are more destructive to the gut lining than others. Indomethacin is recirculated through the liver and reintroduced into the duodenum in bile, which causes repetitive damage.²³³ Nabumetone, however, is a pro-NSAID and is activated by action of colonic bacteria and is not recirculated through bile.²³³ Presently, it is the only NSAID that does not increase small intestine permeability.

- **Cytotoxic Drugs** - Cytotoxic drugs are just that, they are toxic to the cells they come in contact with-including cells of the digestive tract. Drugs such as methotrexate, azathioprine, cyclophosphamide, chlorambucil, and cyclosporine are the most common.^{224,228,231}
- **Steroids** - Steroids effect LGS through the same channels as the NSAID's only with greater abilities of suppression. Proper immune function is greatly compromised by steroids which have already been shown to be an influencing factor leading to LGS.

NUTRITIONAL

- **Aspartame** - This one time sweetheart of the artificial sweetener world has drawn much harsh criticism **due to reports of its neurotoxic properties** and other negative influences on human health. Recently, studies by Endocrinologist H.J. Roberts have indicated aspartame may cause dysbiosis.^{15,16} Although the exact mechanism is not known at this time, Dr. Roberts found that **dysbiotic symptoms were relieved when the aspartame was removed.**¹⁵
- **Dietary Fiber** - Dietary fiber is crucial for adequate health of the gut in any disease condition. Its benefit in LGS seems to be multi-fold. Fiber **increases gut motility through bulk**. This assists the body in passing waste before it is reabsorbed into the system. Fiber **absorbs waste from the blood stream** and helps to pass them. Insoluble fiber is particularly helpful in scrubbing the gut lining to **stimulate production of protective mucous** and removing old epithelial cells and pockets of digested food that accumulate in the small intestines.^{10,13,62}
- **Other Dietary Contributors** - The American Industrial Revolution marked the evolution of our diet, which gradually **changed from whole grains, fresh fruits and vegetables, raw milk, butter and cheese to canned and processed foods that could be easily packaged and prepared**. Soil was depleted of nutrients as rural America migrated to the urban developments creating a need to store food for the masses in a manner that it would not be spoiled or consumed by rodents.⁶² In the mid-1800's, Industrialists conducted experiments to deter rodents from destroying stored foods. They discovered removing the outer layer of grains prevented rodents from consuming it.⁶² This led to the invention of a machine to 'polish rice' and render it storable in a form that would not be consumed by the rodent population.⁶² One outspoken critic of such processed grains was a health advocate who manufactured a product called 'dyspepsia bread'. He traveled the big city circuit on the East Coast preaching the virtues of a healthy diet. He was credited as the first to say 'You are what you eat' and often concluded his public appearances by yelling, 'And put back the bran!' He developed quite a following as he traveled from city to city extolling the virtues of a healthy diet. He kept producing his 'Dyspepsia bread' which was the first commercial form of fiber formulated for indigestion and improving elimination. His bread is still with us today in a much different form but still bears the same name of Sylvester Graham known as 'Graham Crackers.'

Sylvester Graham was a man far ahead of his time with an uncanny vision and a sixth sense for knowing the outer layer of grains contained essential nutrients for life. The rodents instinctively knew



it and avoided polished grains. Shortly after the introduction of 'processed grains', massive clusters of people began suffering with a new disease called 'Beriberi' which means, 'I can't, I can't'.⁶² It was not discovered until 1920 that the **outer layer of grains contain B-complex nutrients**.....the same nutrients destroyed by 'polishing rice'.⁶² 'Beriberi'⁶² is now known as the B-vitamin deficiency disease.

- **Deficient EFA** - Essential fatty acids are vitally important in preventing and healing LGS. Their function in human nutrition is greatly underemphasized for the prevention of disease and the importance in general maintenance. The newest diet fads preach the evils of fats while forgetting the absolute need for EFA's. This has created a whole new group of individuals who will be predisposed to LGS. EFA's are instrumental in proper function of all the organ systems supporting the healing of LGS.^{10,58,115}

In the interest of being brief, we will discuss only the critical factors of EFA's in PG synthesis and their relationship to Leaky Gut Syndrome. Delta-6 desaturase (DDS) enzyme must be present for the EFA's CIS, LA, and ALA, to be converted to PGE1, PGE3 and PG13 respectively. DDS is greatly inhibited and eventually destroyed by alcohol. In addition, the biochemistry of converting ALA to PGE3 and PG13 must first convert to eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) before PGE3 and PGE13 can be manufactured. This also requires DDS.⁵² Consumption of **saturated fats, alcohol, lack of exercise, smoking and stress all inhibit the production of DDS**. This leads to decreased PGE1, PGE3 and PG13.^{10,52} Deficiency of these important prostaglandins creates many forms of behavior changes such as **depression, anxiety, variety of phobia's, psychosis and neurosis syndromes**.^{10,52} PGE1/PGE3/PG13 contribute to the production of cyclic AMP, which is an important anti-inflammatory chemical.^{10,52} In addition, PGE1/PGE3 block the release of arachidonic acid and the formation of PGE2/leukotrienes, therefore **reducing pain from inflammation**.¹⁰

The PGE1/PGE3 activities are critical in health or disease of membrane/connective tissue in the body. Therefore, **PGE1/PGE3 must be present to arrest, reverse and heal the Leaky Gut Syndrome**.

SIGNIFICANCE OF EFA DEFICIENCY

Importance of Essential Fatty acids:

- Major source of energy
- Maintain strength of membrane tissue, help prevent LGS, work with Saccharomyces boulardii helping to prevent increased gut permeability.
- Metabolic pathway of EFA conversion to PG's.^{10,31,81}

LABORATORY TESTING & ASSESSMENT

Leaky Gut Syndrome should be suspected in many people, particularly those with a diagnosed disease. Many laboratory tests can be used to reveal the assorted problems that occur with this syndrome. Leaky Gut Syndrome is as it says a 'syndrome' and not a diagnosable disease such as cancer, ulcers, hypertension and the like. However, Leaky Gut Syndrome is a **precursor to disease and its "diagnosis" is crucial to beginning therapy to prevent or improve other diseases** or potential diseases. Three important laboratory impressions with LGS include:

- Dysbiosis Metabolic Markers
- Digestive Efficiency Panel
- Gastrointestinal Health Panel



DYSBIOSIS METABOLIC MARKERS

This urine test gives an accurate picture of possible pathogenic presence of eight Bacteria or Protozoa, Clostridium, and four Yeast/Fungal markers. The sample needed is a first morning catch of urine. The Dysbiosis Metabolic Markers test measures not only the presence but also the degree of colonization of pathogenic organisms. By measuring levels of metabolic by-products specific to certain species of organisms, we can get a picture of the bacterial health of the GI tract. When the results are properly interpreted, a regimen can be devised to rid the body of the invading pathogens and reintroduce healthy flora into the system. This action is necessary in order to heal a Leaky Gut.

DIGESTIVE EFFICIENCY PANEL¹³³

This fecal test measures a broad range of indicators giving us a very graphic view of the digestive efficiency of enzymes, bile, bacteria, and integrity of the gut lining. The Digestive Efficiency Panel measures levels of chymotrypsin to assess pancreatic exocrine activity, fat presence-to determine proper absorption including the fat soluble vitamins, carbohydrates-for proper enzyme activity and potential yeast growth; occult blood, fecal pH (a measure of dietary imbalance), transit time, and retention time. Many potential dietary factors leading to or involved with Leaky Gut Syndrome can be uncovered in this test.

GASTROINTESTINAL HEALTH PANEL

This comprehensive test measures almost all factors relating to GI health. This three stool and two saliva specimen lab will give you seventeen markers of GI function. The major indicators in the stool samples reveal the presence of yeast and pathogenic bacteria, ova from parasitic organisms, giardia, cryptosporidium, C. difficile, amoeba, secretory IGA (the protective immune layer of the GI tract) lysozyme (a measure of GI inflammation), and others that have previously been discussed-chymotrypsin, occult blood and fecal pH. The saliva portion of this lab tests for amoeba antibodies, H. pylori antibodies, toxoplasma antibodies, and anti-gliadin SigA (an indicator of gluten sensitivity). The GI health panel literally leaves little to the imagination as most of the major precipitating factors for Leaky Gut Syndrome can be identified.

OTHER LABORATORY TESTING WHICH MAY BE CONSIDERED

- **Amino Acid Analysis** – This can be done using blood or urine specimen. Results may indicate insufficient amino acid levels for proper healing of the gut or lack of absorption which can be potentially linked to LGS. This test measures up to 40 amino acids.
- **Organic Acid Analysis** – This lab measures the energy production of the Krebs's Cycle. Deficiencies in these markers can be indicative of toxic buildup in the body causing interference in normal metabolic pathways. Each marker is indicative of a digestive deficiency.
- **Fatty Acid Analysis** – A plasma test which measures RBC membrane levels of Omega 3, 6, 9, saturated, odd chain and trans-fatty acids. Proper levels of the beneficial fatty acids (Omega 3, 6, and 9) are necessary for proper gut function and maintenance.
- **IgG 1 & 4 Food Antibodies** – These specific markers of food allergies are often due to LGS. Once they are present, they inflame LGS. Up to 90 common food antibodies may be tested. This test is a serum test and is very helpful in assisting a patient in avoiding foods that can influence and exacerbate LGS and overall health.



- **Adrenal Stress Index** - Measures daily cortisol output in saliva at four strategic time frames, DHEA (the precursor to all hormones and cortisol), the salivary secretory IgA – (the protective layer of the GI tract), and anti-gliadin – (Gluten sensitivity). This lab gives us an excellent picture of the patient's health and the factors that can hinder improvement.

MANAGING/CORRECTING LGS

After the presence of LGS has been confirmed through assessment, steps can be taken to correct the situation. Compliance in these areas is critical.

WATER^{1,10,133,134,135,68,69}

Adequate consumption of water is imperative for top performance of the GI tract. Since the GI tract is the site for removal of nutrients and deposition of waste, water is needed for both transfer across the membranes for absorption and flushing of the impurities out of the system. An approximate water intake recommendation is ½ ounce per one lb. body weight daily; this is a minimal recommendation.

Do not drink tap water. The quality of municipal tap water and water from some wells is not what it was some decades ago. A combination of toxic waste and ground water pollution by way of fertilizers, pesticides, and seepage of acid rain has greatly diminished water purity in many areas. **Municipal sources in the U.S. use high levels of chlorine to kill most of the pathogenic organisms.** This, however, translates into a much higher intake for those drinking from this supply. Chlorine kills beneficial bacteria in our system. It is also a xeno-estrogen, which means that it mimics estrogen in our bodies and clogs cellular binding sites meant for estrogen. This is not beneficial to human health.

Another chemical added to municipal water is fluoride. Fluoride and chlorine are found in the same chemical family. With the advent of fluoride toothpaste, rinses, and treatments, many patients are getting too much exposure. A healthier alternative is to ensure proper intake of calcium, magnesium and zinc to prevent dental cavities and osteoporosis.

Water treated with a softener may contain high levels of sodium, which contributes to **hypertension, water retention, weight gain, difficulty in losing weight, swelling under the eyes, and additional stress to the kidneys, liver, gallbladder, heart and GI tract.**

The majority of data available indicate Ozone water purification is superior to other units on the market. Ozone kills all microorganisms including bacteria, viruses and parasites.⁶⁵ The majority of large cities outside the U.S. use ozone purification as their primary method of maintaining safe drinking water.⁶⁵ Water treatment facilities with ozone have been constructed in a majority of the world's largest cities, again, with the exception of the U.S.⁶⁹

Again, hydration of all cells is crucial for good health. **Most individuals are dehydrated** and are not aware that the following signs and symptoms are associated with this common syndrome:^{1,10,133,134,135,68}

- Thirst
- Hunger
- Fatigue
- Pain throughout the body and all of the joints
- Headaches
- Dry skin
- Constipation
- Wrinkled skin
- Aged/Old skin
- Chronic infections with poor immunity
- Decreased life span

Two-thirds of the body is water.¹⁹¹ The blood is 90% water and the muscles are 85% water.¹⁹¹ Every organ and gland requires regular hydration with no less than two liters per day. This assists the kidneys in separating urea from the blood¹⁹¹ and lubricates the intestines and skin as the blood carries nutrients to all parts of the body. Inadequate water contributes to leaky gut syndrome and all of the associated ramifications.^{68,191}

LIFESTYLE AND DIETARY RECOMMENDATIONS^{10,14,33,41,48,49,54,68,79,81,100,102,120,121,197,233}

Eat Live Foods. There is tremendous merit in fresh vegetable juice and live foods. **Anything cooked in excess of 132 degrees Fahrenheit compromises the nutritional value** to different degrees depending on the sensitivity of each vegetable. Live foods contain all the proper nutrition that a healthy digestive system requires. Adequate nutrient load, proper fiber, natural source of enzymes to improve digestion and high water content are common properties of live foods. Fresh fruits, vegetables, grains and nuts are your best sources. In particular, cruciferous vegetables found in the cabbage family contain high levels of phytonutrients known as thiols and glucosinolates that have been found to be highly beneficial in repair and maintenance of the GI tract along with aiding in detoxifying the liver.^{220,221,222,223,224,225,226,227,228,229,230,231} Live foods help cleanse the liver of its buildup of impurities and toxins.

Before regeneration management is initiated for any condition, the liver must be detoxified.¹ In LGS, the nature of the disease itself puts a great strain on the liver.^{1,63,133,134,135} On the other side of the equation, if the patient has a highly toxic liver, the LGS may never heal as excess toxins are secreted in the bile, which empties into the duodenum. Detoxification of the liver is crucial.

Dietary recommendations will vary from person to person as we all have different likes and dislikes. Also, a person with a severe leaky gut will need to be more aggressive than someone that is looking to prevent the syndrome. By keeping some simple guidelines in mind, LGS can be greatly improved or prevented.

- **Avoid refined and processed foods** – This includes sugar and white flour, saturated fats and hydrogenated oils. These foods are devoid of beneficial nutrients, high in calories and have many chemical additives that stress the system.
- **Eat high quality proteins** – The best sources are plants such as soy. However, fish, chicken and turkey are also preferred. Organic sources free of hormones, pesticides and antibiotics are highly recommended. In patients with severe LGS where digestion and absorption are greatly compromised, (i.e. Fibromyalgia, Chronic Fatigue, etc.) predigested sources may be the best recommendation (see Supplement section).
- **Avoid alcohol** – Although reports have determined that alcohol consumption in moderation has some health benefits, as we have discussed previously, alcohol has a detrimental effect on patients with LGS. Three to six months of abstinence combined with good supplementation, diet, and lifestyle program can repair much of the damaged framework. At this point, alcohol can be reintroduced in moderation.
- **Avoid dairy when possible** – Dairy products are very difficult to digest for some patients, particularly those with inadequate supplies of lactase enzyme. As we age, this enzyme depletes in our bodies making dairy more difficult to digest. If dairy is consumed on a regular basis, it is **highly recommended that the patient be on a quality multi-strain probiotic** to aid in proper digestion. Another detriment to dairy in the digestive system of a LGS patient is its high rate of allergenicity. This is important considering the direct absorption of some of these proteins into the blood stream.
- **Avoid carbonated beverages** – Carbonated beverages alter the pH of the stomach. Caffeinated beverages should be reduced or at least consumed with meals as they stimulate acid secretion. Herbal teas are preferred.



- **Increase fiber intake** – With a proper diet of live foods, this will occur naturally. Fiber helps cleanse the system and carry waste away. Proper water intake is crucial. Another benefit of fiber in LGS is the scrubbing action to help remove old damaged cells from the lining of the GI tract. A combination of soluble and insoluble fiber provides the most benefit.^{11,43,121} A coarse-ground psyllium/flax seed hull mix is preferred. A mixture that is ground too fine is not as beneficial since it will not “scrub” the intestinal walls well enough.
- **Eliminate aspartame products** - Ironically, aspartame is promoted to assist in weight loss programs. However, this product perpetuates allergic responses **and promotes weight gain or contributes to difficult weight loss.**^{10,15,16} Additionally, experts in food allergy management have consistently shown patients placed on a food “allergy-free” diet lose an average of 10 pounds in the first 30 days^{1,10,133} This weight loss is due to stopping the mucous allergic reaction that occurs in the gut during the IgA response. This response coats allergenic foods with a thick mucous protecting the gastric mucosa and preventing digestion.^{1,10,133}

Aspartame has also been found to convert into methanol (a highly toxic alcohol in the human body) and/or diketopiperazine (a potential carcinogen) in conditions of high heat and pressure that may be found during transportation of canned beverages containing aspartame.^{15, 16, 232}

- **Chew food thoroughly** - Chew each bite of food no fewer than ten times. Chewing food is the very first stage of digestion. Compromised mastication yields incomplete digestion. Therefore, it is very important to begin each digestive session with thorough and complete mastication.

EXERCISE

The benefits of regular exercise are indisputable. These benefits are also felt in the digestive system. Along with more thorough churning of stomach contents, and intestinal peristalsis, exercise promotes more efficient use of nutrients and stimulates release of toxins in the body. The increased toxicity of the abdominal musculature has a very positive benefit on enhancing the overall physiology of the internal organs.⁶⁴

SUPPLEMENTS

- **Probiotics** – As mentioned previously, these beneficial bacteria are absolutely essential to proper GI health. A good probiotic should have multiple strains due to the many different environments found in the GI tract. In other words, the same bacteria that thrive in the high acid environment of the stomach would not survive for long periods in the bicarbonate rich alkaline environment of the duodenum. A synergistic combination that can colonize readily in all different areas of the GI tract is preferred. The **probiotic must not be tableted as this creates heat which kills the bacteria.** Good probiotics should be refrigerated and be convenient for easy compliance for the patient. The following list contains some of the more common beneficial bacteria used in probiotic formulas and their beneficial effects.
- **Lactobacillus Acidophilus** gives support to control diarrhea, reduces bad cholesterol by conversion to coprostanol, allowing elimination. Helps reduce lactose intolerance. Controls candida overgrowth, protects GI mucosa and strengthens the immune system for defense.
- **Lactobacillus Brevis** inhibits effects of pathogens, strengthening immunity.
- **Lactobacillus Bulgaricus** produces lactic acid therefore promoting a healthy GI environment, growth of friendly bacteria. Fights GI infection. Overall immune support.



- **Lactobacillus Casei** promotes peristalsis, elimination, and balance of microbial community. Prevents diarrhea and supports the immune system.
- **Lactobacillus Helveticus** and **Lactobacillus Lactis** compliment GI environment and render mutual physiology.
- **Lactobacillus Plantarum** produces lactic acid, inhibiting growth of GI pathogens. Fights against flatulence.
- **Lactobacillus Rhamnosus** has strong affinity for mucosal support through adhering to mucosal membrane, inhibits fungal/bacterial vaginal infections and promotes infection prevention.
- **Lactobacillus Salivarius** fights against flatulence. It is antibiotic resistant and therefore fights against antibiotic - induced diarrhea.
- **Streptococcus Thermophilus** represents carbohydrate processing through fermentation. Enhanced digestion of milk, inhibits harmful bacteria.
- **Bifidobacterium Breve** and **Bifidobacterium Bifidum** are prominent in the ileum and vagina. B. Bifidum is responsible for production of specialized acids preventing risk of candida overgrowth and pathogenic bacteria. Additionally, B. Bifidum contributes to vitamin B production and bile detoxification, which compliments predictability of estrogen recycling. Nitrogen retention in children is another benefit of B. Bifidum.
- **Bifidobacterium Infantis** and **Bifidobacterium Longum** have many positive functions in the GI tract. They both are the main inhabitant of every healthy infant's GI tract and are synergistic with B. Bifidum. B. Longum compliments prevention of potential nitrite toxicity from the diet.
- **Bacillus Subtilis** is beneficial in inhibiting intestinal putrefaction, flatulence and diarrhea.
- **Saccharomyces Boulardii** is one of the most beneficial of all friendly GI bacteria in promoting production of SigA in the GI wall, enhancing beneficial effects in the upper GI tract with positive enzyme activity, fighting traveler's diarrhea and Crohn's Disease. Due to the production of SigA in the gut mucosa this friendly bacteria is the **most beneficial for fighting leaky gut syndrome**.

Probiotic Summary:

- B-vitamin production
 - Reduces high cholesterol
 - Antibacterial
 - Antiviral
 - Antifungal
 - Anticarcinogenic benefits
 - Promote digestion efficiency
 - Bloating
 - Compliment estrogen recycling reducing risks of osteoporosis
 - Reducing menopausal symptoms
 - Reducing flatulence
 - Promote healthy GI acidity
 - Compliment infant digestive function
 - Strengthen infant immunity
 - Manufacture lactase for milk digestion
- **Predigested Protein** - These easily assimilable proteins can be found in fish and soy sources. Space-age technology has uncovered bioactive polypeptides; amino acids in a rich complex with minerals, fats and phospholipids in a form that requires no further digestion and is ready for absorption/assimilation.

Entering the duodenum, these substances begin repairing the weakened mucosal membrane, decreasing the excessive permeability associated with LGS. No further digestion is needed and passage directly through the gut/blood barrier is initiated. A process called chemotaxis,¹⁹¹ which



transports the amino acids/polypeptides to the areas of greatest demand for urgent repair, is a built-in automatic process within the human body.¹⁹¹

Physicians have reported Predigested proteins helping the following conditions:^{1,6,61,139,221,233}

- Ascites
- Chemotherapy
- Crohn's Disease
- Chronic fatigue syndrome
- Colitis
- Diabetic ulcers
- Diverticulosis
- Diarrhea
- Elevated liver enzymes normalized
- Esophageal varices
- Hepatitis
- Irritable Bowel Syndrome
- Indigestion
- Leaky Gut Syndrome
- Leukemia
- Low serum albumin
- Malabsorption
- Malnutrition
- Multiple Sclerosis
- Muscle wasting
- Neurofibromatosis
- Stomach upset
- Wound healing

Predigested Soy is a ready source for direct absorption/assimilation as it enters the duodenum carrying healing properties for the building blocks, yielding new cellular membrane tissue, re-building connective tissue and repairing structural damage as it works toward maximum medical improvement.

Some patients may be sensitive to soy-based protein (such as cancer patients) due to the phytoestrogens present in soy protein. Therefore, fish sources are an excellent protein alternative. New technologies, however, have produced soy products that are devoid of phytoestrogens. This new process opens the doors to soy as the perfect predigested protein. **40% of all cancer-related deaths are directly attributed to protein malnutrition.**¹³³

- **Vitamins** – Vitamins are needed to help balance and maintain proper metabolic activity. In numerous studies, Americans are vastly deficient in essential vitamins. Supplementation is essential to maintaining good health or reversing a pathologic condition such as LGS. A good multi-vitamin should contain a broad spectrum of nutrients, have dosing divided into 2 to 4 times daily; and have at most a microthin coating that will not hinder dissolution. The following is a list of recommended vitamins and their functions in promoting proper digestion:
 - **Cyanocobalamin (vitamin B₁₂)** is a deficiency in Vitamin B₁₂ that can cause constipation, GI disturbances, anemia, or neuropsychiatric problems.
 - **P5P** Deficiency symptoms include ulcers, duodenal ulcers and stress ulcers. Low levels of this nutrient can be found in newborn infants, women using oral contraceptives and alcoholics.
 - **Folic Acid** is a good antidote for chronic diarrhea. Deficiency can cause GI symptoms, anorexia and chronic inflammatory bowel disease.
 - **Thiamine (vitamin B₁)** produces energy from food-especially carbohydrates. Deficiency symptoms include loss of appetite and constipation.
 - **Riboflavin** aids in energy production and cellular respiration with deficiency often found in the elderly.
 - **Pantothenic Acid** Deficiency symptoms include abdominal pains, nausea and vomiting.
 - **Biotin** is needed for people who experience a loss of enteric gut microflora from antibiotic therapy or altered gut motility. Deficiency causes anorexia, nausea, hypercholesterolemia and pale smooth tongue.

- **Vitamin D** A lack of sunshine can cause a vitamin D deficiency. Deficiency symptoms include burning of the mouth and throat, diarrhea and osteoporosis. Vitamin D is needed for normal growth of bones and teeth in children and enhances immunity.
- **Vitamin E** is a powerful antioxidant that retards aging and increases lifespan of red blood cells. Also prevents blood clots and leg cramps and has shown to be cardio and pulmonary protective.
- **Beta Carotene** acts as an antioxidant and helps Vitamin A supply retinol equivalent.
- **Minerals** – Running hand-in-hand with vitamins, minerals are essential for proper maintenance and repair. Minerals must be chelated to a small protein or amino acid to be absorbed in the duodenum. In patients with LGS, this process becomes jumbled as large non-binding proteins may be able to travel across the intestinal barrier into the blood stream. This leaves the patient with a strong potential for mineral deficiency. Supplementation is strongly recommended for good GI health. The following is a list of the most common minerals necessary for proper GI and metabolic function and repair.
 - **Iron** Fumarate is the most prevalent worldwide nutritional deficiency and the most frequent cause of anemia. Deficiency of iron causes a reduction in the oxygen carrying capacity of the blood, hair loss, fatigue and dizziness.
 - **Zinc** is important in the growth of the reproductive organs. It promotes a healthy immune system and the healing of wounds.
 - **Calcium** is vital in the formation of strong bones, in the maintenance of regular heartbeat and the transmission of nerve impulses. Deficiency can cause abnormal muscle contractions, nerve transport abnormalities and poor hormonal activity.
 - **Copper** is important in the production of energy, the healing process and sensitivity to taste. Deficiency can cause diarrhea and osteoporosis.
 - **Potassium** deficiency symptoms include acne, constipation, glucose intolerance and salt retention. Potassium citrate helps to maintain stable blood pressure.
 - **Chromium** aids in food metabolism, enzyme activation and regulation of cholesterol. Deficiency can cause dermatitis, dementia and diarrhea.
 - **Selenium** activates an antioxidant enzyme that may protect the body against cancer.
 - **Molybdenum** aids in the body's protection of ATP. Deficiency can cause sulfite sensitivity.
 - **Vanadium** may improve glucose control in individuals with non-insulin dependent diabetes mellitus. Vanadium plays a role in building bones and teeth.
 - **Manganese** deficiency symptoms include glucose intolerance, hypercholesterolemia, pancreatic damage, nausea, weight loss and disturbed carbohydrate metabolism.
 - **Magnesium** can work as an anti-inflammatory. Deficiency can cause GI spasms.



- **Essential Fatty Acids** – As discussed in detail earlier, EFA's play a pivotal role in the health of the GI tract and the prostaglandin cascade. EFA's are best found in flaxseed oil, borage oil, evening primrose oil or cold water fish oils. Each has clear benefits in providing EFA's. **Flaxseed oil is the EFA source of choice due to its availability, relatively low cost, high level of omega 3 oils, very low potential for heavy metal content and fairly good palatability.** A good flaxseed oil should be packaged in amber glass to prevent potential leeching of plasticizers into the product and should first be cold pressed to lessen viscosity and reduce oxidation. Borage oil is a good source of EFA's, but tends to be less palatable. Both oils, if packaged in gel cap form, must be taken in doses approaching 10 to 15 capsules to be therapeutically effective. EPO is excellent (particularly for females) due to its hormone stabilizing ability, but can be cost prohibitive. Cold water fish oils have mixed palatability in some forms and in regular dosing **may contain higher than acceptable levels of heavy metals.**
- **Fiber** - Fresh fruits, vegetables and grains are the best sources of fiber. If supplementation is needed, use products that contain a combination of **FlaxSeed and Psyllium**, as mentioned previously. This combination is a good mix of soluble and insoluble fiber. Optimal fiber products **should not contain sugar or artificial sweeteners.**
- **Enzymes** - As discussed at length previously, enzymes are necessary for proper digestion to occur. Many cases of indigestion, bloating and upper GI gas can be relieved or prevented using digestive enzymes. Supplementation of digestive enzymes is extremely important in treating LGS.
 - **Pancreatin** - Proteolytic enzyme that assists in digestive enzyme replacement. Deficiency causes an increased risk of intestinal infection.
 - **Bromelain** - Group of enzymes used in digestion to help break down proteins so the body can assimilate the nutrients. Has also been used successfully in arthritis and other destructive diseases where enzymatic degradation of damaged tissue is necessary.
 - **Pepsin** - Normally present in the stomach. Supplementation of pepsin aids in thorough protein digestion.
 - **Oxbile** is a natural source of bile and bile acids that aid in digestion and transportation of fat. Highly beneficial in patients who have undergone gallbladder removal or sluggish gallbladder performance.

AMINO ACIDS

- **L-Lysine** - Essential contribution to the production of antibodies, hormones and enzymes. Necessary for tissue repair, collagen formation and protein metabolism with specific affinity for muscle growth. This is one of nine essential amino acids required from the diet. However, it is best obtained from supplementation.
- **N-Acetyl-L-Cysteine**-The most absorbable form of L-Cysteine promoting increased immune strength. Stimulates healing, detoxification, affinity for connective tissue, gut membrane and liver.
- **Methionine** - Important amino acid in preventing fatty liver, fights food allergies, compliments digestion, stimulates circulation, works with antioxidants in neutralizing lipoprotein-to reduce risk of arterial fat accumulation, and detoxifies and promotes muscle strength.
- **Glutamine** - Critical for gallbladder support in SigA management and gut immune physiology, helps regulate blood sugar balance, increases energy and mental clarity, compliments brain function.



OTHER NUTRACEUTICALS FOR LGS

- **Phosphatidyl Serine, Phosphatidyl Choline, Phosphatidyl Inositol, Phosphatidyl Ethanolamine**
- Helps improve cell fluidity, supports the adrenals, and reduces stress subsequently lowering cortisol levels. Phosphatidyl Serine is a source of fatty acids contributing to repair of the neural myelin sheath. Phosphatidyl replacement should be recommended for patients if elevated cortisol levels are found by way of an adrenal stress index lab test.
- **Malic Acid** - Compliments cellular energy production, eliminates cellular lactic acid and physiological muscle relaxant. Important in patients suffering with Fibromyalgia.
- **Betaine HCl** - Beneficial for digestion and the formation of methionine from homocysteine.
- **Inositol** - Required for proper formation of cell membranes. It affects nerve transmissions and helps in transporting fats within the body.
- **PABA** - Enhances the effects of cortisone, estrogen and possibly other hormones by delaying their breakdown in the liver. Also prevents or even reverses the accumulation of abnormal fibrous tissue.

HOMEOPATHICS

Homeopathics are an excellent addition to any health condition regimen due to its lack of side effects, interactions and contraindications. In LGS, all therapeutic recommendations must pass through an already compromised gut in order to stimulate healing. Homeopathics can be used sublingually to avoid this problem. **Homeopathics can be used in conjunction with all other therapies.** Since LGS can present a multitude of signs and symptoms and have a multitude of potential causes, combination homeopathic agents may be the best choice for those not highly skilled in single remedies. The following list of single remedy homeopathics can be used as a reference for choosing a combination product that may cover a multitude of symptoms related to LGS.

- **Candida Infection**
 - Astragalus Officinalis
 - Baptisia Tinctoria
 - Borax
 - Calcarea Carbonica
 - Candida Nosode
 - Echinacea Angustifolia
 - Kreosotum
 - Lycopodium Clavatum
 - Nux Vomica
 - Phosphoricum Acidum
 - Pulsatilla Nigricans
 - Sepia Succus
- **Fibromyalgia Like Symptoms-** Aching, Stiffness, Fatigue, Pain Of Unknown Origin, Poor Concentration, Depression.
 - Alumina
 - Argentum Metallicum
 - Berberis Vulgaris
 - Conium
 - Ferrum Metallicum
 - Gelsemium Sempervirens
 - Guaiacum
 - Hydrogen
 - Lachesis Mutus



- Phosphoricum Acidum
- Rhus Toxicodendron

- **Flatulence, Constipation, Belching and Abdominal Discomfort**
 - Belladonna
 - Chelidonium Majus
 - Colocynthis
 - Lycopodium Clavatum
 - Natrum Sulphuricum
 - Nux Vomica
 - Phosphorus
 - Pulsatilla
 - Veratrum Album

- **Carbohydrate Cravings**
 - Colchicinum
 - Lacticum Acidum
 - Lycopodium Clavatum
 - Phosphoricum Acidum
 - Phosphorus
 - Syzygium Jambolanum
 - Uranium Nitricum

- **Intestinal Parasites**
 - Baryta Carbonica
 - Calcareo Carbonica
 - Cina
 - Ferrum Metallicum
 - Mercurius Sulphuricus
 - Natrum Phosphoricum
 - Sabadilla
 - Spigelia Anthelmia
 - Teucrium Marum Verum

BOTANICALS/HERBS

The test of time has proven that herbal products are effective at treating digestive tract problems. Therapies with herbs date back thousands of years. There are literally hundreds if not thousands of different formulas available today, most containing combinations of herbs. It is actually simpler to make recommendations in manufacturers than specific products. Find a quality company that uses a standardization process, but keeps the product in its pure form. **Capsules and alcohol extracts (liquid botanicals) are the preferred dosing form** due to ease of use, stability, accurate dosing and lack of excessive heat or compression in processing.

The following herbs have all shown to be beneficial in treating signs, symptoms and underlying causes of LGS:

- **Alfalfa** – Aids in healing allergies, arthritis, morning sickness, peptic ulcers, stomach ailments and bad breath; cleanses the kidneys and removes poisons from the body; is an excellent blood purifier; improves the appetite and aids in the assimilation of protein, calcium and other nutrients.

- **Aloe Vera** – Helps alleviate constipation, aids in healing burns and wounds, canker sores, cold sores, ulcers, acne and digestive disorders. Do not ingest Aloe Vera if the aloin is left in it because it has a strong laxative effect.

- **Barley** – Assists in the digestion of carbohydrates and proteins.



- **Beet Root** – Promotes regeneration of liver cells, greatly assists metabolism of fats.
- **Blessed Thistle** – Used for gas, constipation, upset stomach, liver and gallbladder problems.
- **Boraphed** – Traditionally used as an appetite stimulant, possesses strong anti-bacterial and anti-pyretic properties.
- **Cascara Sagrada** – Stimulates the secretions of the entire digestive system; helps prevent colon and constipation problems.
- **Cayenne** – Used for stomachaches, cramping and diseases of the circulatory system.
- **Chamomile** – An excellent cleanser and toner of the digestive tract; aids in calming the nerves; helps decrease constipation, expels worms and parasites; improves the appetite.
- **Chelidonium** – Tonifies the liver and gallbladder.
- **Comfrey** – Aids in healing respiratory ailments, mucous membranes, lungs and wounds; it is soothing to the gastrointestinal tract; aids in cell proliferation; helps promote the secretion of pepsin and is a general aid to digestion.
- **Dandelion** – Used for poor digestion and water retention.
- **Dee Plee** - Helps to normalize digestion, especially useful in treatment of diarrhea.
- **Edony Tree** – Normalizes the entire digestive tract. (*Do not take while pregnant*).
- **Fa Thallaai** – Anti-inflammatory and anti-spasmodic activity, especially effective in bacterial diarrhea and viral infections.
- **Fennel** - Decreases constipation, and is carminative.
- **Garlic** – Is extremely effective in dissolving and cleansing cholesterol from the blood stream; it stimulates the digestive tract; kills worms, parasites and harmful bacteria; relieves gas and cramps.
- **Ginger** – Aids in fighting colds, colitis, digestive disorders, flu and gas; it helps increase the secretion of saliva; is excellent for the circulatory system; relieves nausea. (*High amounts can lead to miscarriage*).
- **Golden Shower/Khuun** – Helps maintain intestinal tone and is anti-diabetic. (*Do not take while pregnant*).
- **Hibiscus** – Normalize the entire digestive tract and in urinary tract infection.
- **Hops** – Soothes the stomach and promotes healthy digestion; remedy for insomnia.
- **Juniper** – Used for upset stomachs and various urinary tract and kidney diseases.
- **Kae Thu** – Relaxes intestines effective in stomach discomfort, as well as symptoms associated with bacterial or viral infection.
- **Licorice Root** – Stimulates the immune system helping to prevent sickness during times of high stress. *May cause water retention*. Deglycerized licorice root reduces water retention potential.



- **Milk Thistle** – Used to relieve congestion of the liver, spleen and kidneys.
- **Myrrh** – Has soothing effects on inflamed tissues in the mouth and throat.
- **Peppermint** – Carminative.
- **Rangoon Creeper** – Anti-bacterial and anti-parasitic.
- **Safflower** – Anti-inflammatory, stimulates the secretion of bile acids. (*Do not take while pregnant*).
- **Schisandra** – Useful for coughs, night sweats, insomnia, thirst and physical exhaustion. Improves functions of liver enzymes.
- **Slippery Elm** – Relieves constipation, helps soothe inflamed tissues of the digestive tract and mucous membranes.
- **Spirulina** – Is an algae containing 65% - 70% protein; it contains 26 times the calcium of milk; also contains phosphorous and niacin and is far more nutritious than any known food; used for rejuvenation and weight reduction; an excellent blood and colon cleanser; very high in Vitamin B12 content.
- **Tam Loeng/Khae-Doh** – Used to treat stomach ulcers and as a digestive aid, as well as possessing anti-inflammatory activity and reduction in blood sugar.
- **Thai Cardamon** – Used to enhance digestion, as well as treatment of an upset stomach.
- **Turmeric** – Traditionally used as an anti-diarrhea and anti-inflammatory. Strong anti-bacterial and liver stimulating properties. (*Do not take while pregnant*).
- **Wormwood** – Used to improve digestion, fight worm infestations and as a remedy for problems involving the liver and gallbladder.
- **Yellow Dock** – A nutritive tonic, high in iron and useful in treating anemia; also nourishes the spleen and liver, thus, being effective for the treatment of jaundice, lymphatic problems and skin eruptions; strengthens, cleanses and tones the entire body; excellent for boils, ulcers, wounds and cleansing the blood.
- **Yo/Mataasuea** – Used as an appetite stimulant and digestive. (*Do not take while pregnant*).

AROMATHERAPY⁶⁶

Aromatherapy has a place in the treatment of all ailments. LGS affects the whole body and places stresses on the system. Aromatherapy can be a key element in helping heal mind and body.

- **Peppermint** - Excellent digestive, anti-inflammatory, and antiseptic properties. Reduces indigestion, flatulence. Fights bad breath, reduces headaches (tension and migraine), rheumatism and increases total energy.
- **Chamomile Roman** - Anti-inflammatory, antibacterial, antiseptic, disinfectant. Fights rheumatism, nervous conditions, depression, anxiety, eczema, asthma, diarrhea, and general relaxant properties.

- **Lavender** - Antibiotic, antiseptic, antidepressant, sedative properties, stimulates wound healing, mood tonic, reduces psychological effects of the shock of injury.

SUMMARY

LGS is a relatively simple ailment in its physiologic form. However, it is without question one of the largest influencing factors in most disease states. In a natural nutritional approach to disease and disease state management, **LGS can be the underlying causative factor to many if not most diseases as we know them.** LGS is also the rate limiting factor in healing many of these diseases. It is obvious beyond doubt that gut function is the key to improving health and preventing disease. Diseases of the digestive tract have skyrocketed in the last couple decades. Many once minor threats to health have increased in prevalence and seriousness with this trend such as heart disease, asthma, obesity, migraines, fibromyalgia, infertility, etc. One thing is certain, all these diseases are influenced by what we put in our mouths and how it comes out the other end. Between these stages a properly functioning digestive system can mean the difference between life and slow death. Leaky Gut Syndrome is treatable and can be prevented with modification of lifestyle, diet, and proper supplementation. Fix the underlying problem that caused the disease and you will aid the patient in recovery and total health.



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