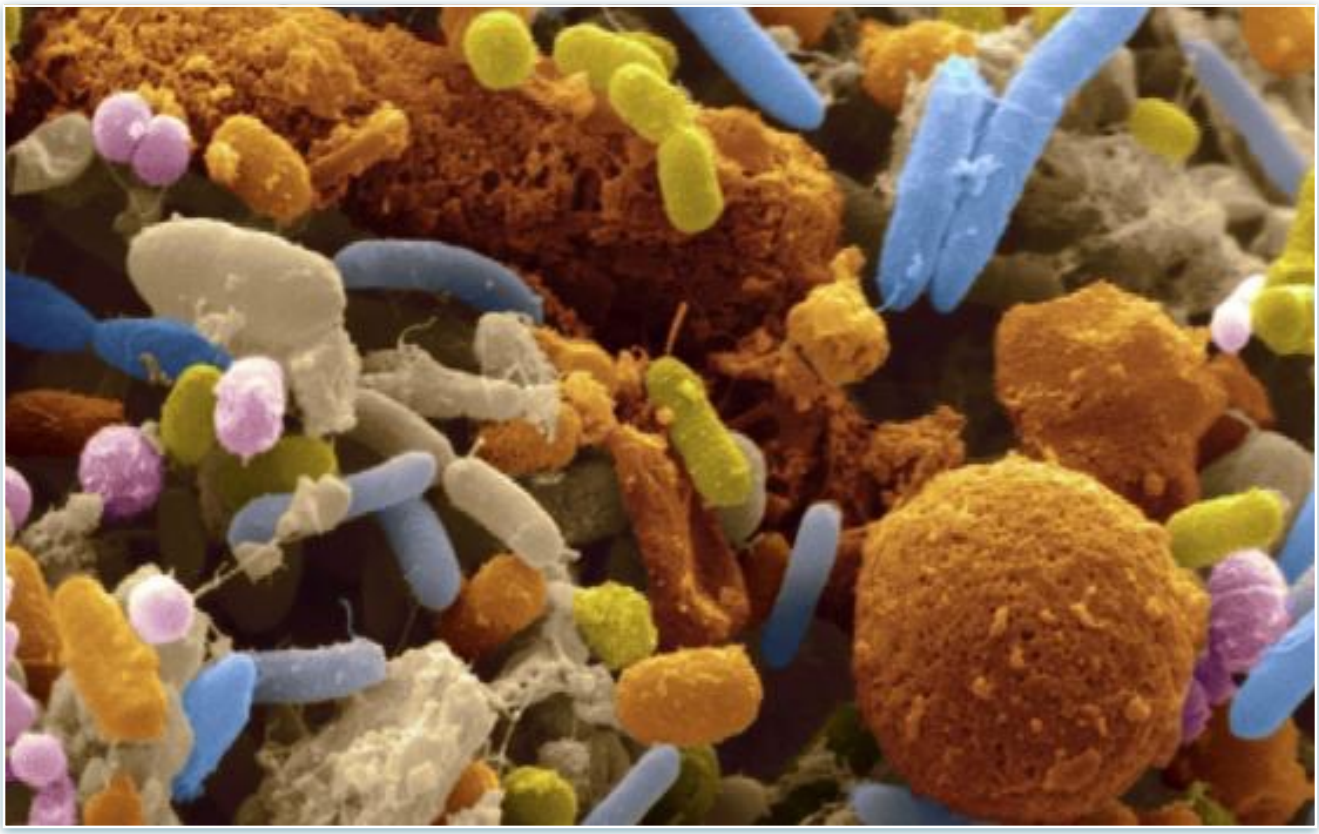
Growing Great Gut Gardens

Dysbiosis of the Intestinal Microbiota



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Introduction

"everything is connected, everything changes - pay attention, Jane Hirshfield"

There is just as much mystery deep in our bowels as there is in our garden soils. Neither ecological systems is completely understood and thus remain mysterious but, like everything else, is connected. What if our autoimmune diseases are an imbalance with the microbial world?

According to the Human Microbiome Project (13) published in 2012, we need to start rethinking what makes us sick. When the gut ecosystem composition becomes altered (actually 'impoverished' in the Western world), a state called gut dysbiosis develops.

Dysbiosis is not a medical term, this condition so is also referred to as microbial imbalance in some literature. This imbalance can lead to changes in the intestinal environment, which may hinder helpful gut microbes in doing their daily functions. Autoimmune, allergic, metabolic and alcoholic liver diseases, Crohn's disease and colitis, colorectal cancer and bacterial infections have all been linked to gut dysbiosis (7).

There is general consensus forming around the role of the micro biome and gut permeability, as well as, how human and microbial health are linked.

Chapter One

Our Second Genome

Composition of Intestinal Biome

What makes me - me? We do not really know what a 'normal' or 'healthy' gut biome looks like or is supposed to be composed of, and scientists may never find out the answer. The relationship with our micro biome that co-evolved over thousands of years has been changed drastically in the last century. It is likely that our gut inhabitants have been forever altered due to our current environmental conditions, changes in our lifestyles and effects of modern medicine (3).

Most types of microbes remain unknown. It is estimated that we know fewer than 1% of the microbial species on Earth. Yet microbes surround us everywhere -- air, water, soil. An average gram of soil contains one billion (1,000,000,000) microbes representing probably several thousand species. An estimated 1,000,000 bacterial species exist on this planet, according to the Global Biodiversity Assessment, yet fewer than 4500 have been described. The greatest genetic diversity of life comes from within the world of microorganisms, yet the least is known about them (12).

Collectively, the number of intestinal microbial cells weighs about 2-3 pounds and is 10x's greater than the number of human body cells, which makes us only about 10% human. The human micro biome is about 150 times larger than the human genome, with an estimated 3.3 million microbial genes (7). This is likely to become our 'second genome'.

Beneficial Functions

What does this 'second genome' do all day? So far, scientists have determined that beneficial functions include but are not limited to:

- breaking down carbohydrates including fibres
- producing amino acids and short chain fatty acids (to nourish epithelial cells of the gut lining)
- manufacturing vitamins, enzymes, and neurotransmitters. A great article explaining the connection between neurotransmitters, nutrition and behaviour can be found here: http://nutritionwonderland.com/2009/06/understanding-bodies-serotonin-connection-between-food-and-mood/

- protecting us from harmful bacteria and outcompeting these pathogens for nutrients
- maintaining intestinal homeostasis and an appropriate intestinal pH levels
- detoxifying the harmful xenobiotics (drugs, pesticides, carcinogens, chemicals)
- developing a robust systemic and intestinal immune system (figuring out what is friend and what is foe in the gut and elsewhere in the body)
- providing signals for epithelial cell renewal and maintaining gut integrity (to prevent the gut barrier from becoming more permeable and breaching)

How Do I Get A Great Gut Garden?

Acquiring a gut biome does not occur randomly. Host factors, environmental cues and self-assemble rules exerted by microbes themselves make the greatest determination(2,3). Host factors are:

- genetics,
- age(1),
- prenatal (womb gut colony inoculation) and post natal environmental exposure (Caesarian section vs vaginal delivery, bottle feeding vs breast),
- diet,
- nutritional status,
- altered bowel activity through diarrhea, constipation and surgery, recurrent infections, medications like antibiotics (in health care and the food system),
- proton pump inhibitors and immunosuppressives,
- personal hygiene (too little vs too much),
- socioeconomic status,
- cultural traditions (2,3,9)
- environmental cues are: population growth and agriculture, changes in environment (such as hospital settings), and public health practices

which shape the balance of beneficial vs aggressive microbial species (3,7).

The destruction of our inner ecosystem surely deserves more attention as global populations run gut-first into the buzz saw of globalization and its microbial scrubbing diet. - Jeff D. Leach

Chapter Two

Signs & Symptoms of Microbial Imbalance

Types of Dysbiosis

Currently there have been 5 types of dysbiosis that has been identified. It is possible to have more than one type of dysbiosis at the same time (8).

Insufficient Good Bacteria

A decrease in friendly bacteria so the production of short chain fatty acids (food for cells in gut wall) and other nutrients is decreased which leads to gut lining breaches.

Small Intestinal Bacterial Overgrowth (SIBO)

An increase of unfriendly bacteria due to one or more factors: low stomach acid, abnormal bowel transit time, surgery, malnutrition, immune deficiencies.

Immunosuppressive Dysbiosis

Medications like antibiotics and those that lower the immune response create an absolute deficiency of normal gut flora. Nutritional deficiencies result with lowered resistance to infection.

Inflammatory Dysbiosis

An inappropriately aggressive immune response to normal gut flora. The immune system may be reacting to gut bacteria or substances produced by them.

Parasites

Parasites are often silent, causing no intestinal issues. The only way to diagnose a parasite is through stool testing.

Symptoms

When any of these forms of dybiosis is active, some or all of, the following symptoms may occur:

Bloating, belching , burning, flatulence after meals, a sense of fullness after eating; indigestion, diarrhea, constipation; systemic reactions after eating; nausea or diarrhea after taking supplements; rectal itching; weak or cracked finger nails; dilated capillaries in the cheeks and nose in the non-alcoholic; post-adolescent acne or other skin irritations such as rosacea; iron deficiency; chronic intestinal infections, parasites, yeast, unfriendly bacteria; undigested food in the stool; greasy stools; skin that's easily bruised; fatigue; amenorrhea (absence of menstruation); chronic vaginitis (vaginal irritation).

It has been speculated that other symptoms, such as impotence, loss of libido, infertility, muscle atrophy, cramps and joint pain, are also linked to malabsorption. A fair amount of research supports this connection. (15)

Dysbiosis can trigger or promote an autoimmune disease due to the diminished population of health promoting intestinal flora and fauna and the influence of harmful microbes that cause the immune system to malfunction.

Chapter Three

Contributing Factors

The Role of Inflammation

Inflammation is part of our immune response to threats. Without inflammation, we can not battle pathogens. Bacterial imbalances can be responsible for an inappropriately weak or overly aggressive immune responses (7).

One theory is that the problem begins in the gut, with the all-important epithelium that lines our digestive tract. This 'internal skin' mediates our relationship to the world outside our bodies.

The microbiota play a critical role in maintaining the health of the epithelium. Should this 'skin' or gut lining breakdown and develop openings, endotoxins (toxic byproducts of certain

bacteria), yeast, parasites and food proteins can slip into the blood stream, triggering an immune system response.

This resulting low-grade inflammation, which affects the entire body, may lead over time to chronic diseases (15).

The gut is our biggest immune system organ. When the body's defence system doesn't recognize a molecule, the very first response is inflammation. The more the intestinal wall is weakened by these inflammatory responses, the more endotoxins and proteins pass through to the bloodstream, which if not corrected will eventually overwhelm the immune system.

With environmental chemicals from food packaging, chlorinated water and GMO foods, these elements that do not occur in nature, are coming in contact with the gut lining. The immune system's response is to recognize them as foreign and the result is an inflammatory response.

We are are what we eat. For a diet to be healing, the foods themselves need to have healing qualities. They must contain the necessary building blocks to restore health and the items that promote disease must be removed.

Chapter Four

Lifestyle & Behaviours to Avoid

Start Making Changes

Antacids

- antacids (8), alters the pH of the stomach which affects optimal digestion and absorption.
- Studies have shown that people who take these medications long term have an increased risk of developing food sensitivities.

Antibiotics

- antibiotics, commonly known gut biome disruptor, especially in early childhood, and with repeated use.

Stress

- physical, mental and emotional stressors changes the intestinal pH balance by affecting multiple hormones: cortisol, estrogen, testosterone, melatonin, and Vitamin D.

- stress increases cortisol which in turn increases appetite and food cravings (especially for sugar), increases body fat, diminishes muscle mass, diminishes bone density, increases anxiety, increases depression, creates mood swings, impairs immune function, impairs memory and new learning, changes menstrual cycles, and increases menopausal symptoms
- stress can lower the number of beneficial bacteria (lactobacilli & bifidobacteria) in the bowel, it can make the gut lining more permeable, and it suppresses an immune molecule called secretory IgA or immunoglobulin A, that supports the health of beneficial bacteria and fights off foreign substances

Chlorine

- chlorine in drinking water prevents the spread of infections and has been common practice for almost a century. However, consumption of chlorinated drinking water has been associated with urinary and GI tract cancers in human epidemiology studies(5).

Round-Up

- glyphosate the active ingredient in Roundup (4,9,10) It is the active ingredient in the herbicide Roundup which acts on bacteria. It has been shown to disrupt gut bacteria in animals, preferentially killing beneficial forms and causing an overgrowth of gut pathogens. Glyphosate residues are prevalent in the Western diet. A European study (Hoppe 2013) involved city dwellers who were unlikely to be exposed to glyphosate except through food sources. Despite Europe's more aggressive campaign against GMO foods than in the Americas, 44% of urine samples contained quantifiable amounts of glyphosate (4).

Hygiene

- extremes in hygiene (too much or too little) (1). Not reacquainting your immune system with the trillions of microorganisms on the plants and in the soil will result in the loss of an interface with the terra firma. Reconnecting with natural ecosystems, will allow you to understand and manage your inner-ecosystem (14).

Nature Bathing

- nature deficit disorder (14) Today, 90% of our day is spent inside. Interacting with nature (even if it is just opening a window) will

improve the diversity and health of the microbes in your home, and those of its inhabitants.

Chapter Five

Conventional Medical Approaches

Probiotics and Nutrition

There is some research suggesting that some probiotics may be effective in a number of ways: modulating the immune system; reducing allergic response; shortening the length and severity of colds in children; relieving diarrhea and irritable bowel symptoms; and improving the function of the epithelium (our internal skin).

Clinical trials have assessed the therapeutic effects of probiotics for several disorders, including antibiotic-or Clostridium difficile-associated diarrhea, irritable bowel syndrome, and the inflammatory bowel diseases.

Probiotic research is a rapidly evolving field. However, the capacity of probiotics to modify disease symptoms is likely to be modest and varies among probiotic strains—not all probiotics are right for all diseases (29).

According to current definitions, probiotics should survive both gastric acid and bile to reach the small intestine and colon where they exert their effects. Clinical investigations on probiotics have used a multitude of probiotic species, both as single strains and multi-species products.

Probiotics are considered dietary supplements; thus, they are not covered by medical insurance and their production is not regulated by the Food and Drug Administration. As such, product quality, purity and viability have been reported to be variable (30).

Because the probiotic marketplace is largely unregulated, it's impossible to know what, if anything, you're getting when you buy a "probiotic" product. One study tested 14 commercial probiotics and found that only one contained the exact species stated on the label.

Many probiotic strains do not colonize the gut and are no longer recoverable in stool 1–4 weeks after stopping consumption. If sustained benefit from a probiotic is desired, continued consumption is required.

Little is known about the effects of nutrition on inducing microbial populations that are either protective and prevent specific diseases, or are damaging and cause disease. It is still not clear if dysbiosis contributes to the symptoms of GI tract diseases or is simply a consequence of these diseases(1).

Many factors muddy the study of the gut micro biome. Most studies are initiated after the onset of disease when the immune and inflammatory processes have already begun. Whether the observed dysbiosis is causative can not be determined.

In addition, medications (antibiotics, immunosuppressives, changes in diet, daily lifestyle and introduction of other environmental factors like hospital settings) are usually not taken into consideration.

The approaches to shape gut microbiota in conventional medicine include: prebiotics (fiber supplements) dietary changes (eat more vegetables), antacid medication, feral microbiota transplantation (where a sample of a healthy person's intestinal ecology is installed into a sick person's gut) and/or the use of antibiotics (3).

Chapter Six

Food-Like Products to Bypass

What to Avoid

GMO Fruit and Vegetables

Genetically modified organisms are species that have had part(s) of their gene sequence spliced with an entirely different organism's genes. This happens in a lab and not in nature and should not be confused with 'breeding' or 'cross breeding'.

GMO fruit and vegetables (such as corn engineered to produce Bt Toxin) or those grown with conventional farming practices due to poor soil management and glyphosate residue (which reduces bioavailability of minerals, and damages the gut biome) in already nutrient deficient produce must be avoided.

Glyphosate is the active ingredient in the product Round-Up and other weed management formulations. Bacillus thuringiensis is known as Bt and is a modified insecticide toxin that has been implanted into the genes of corn.

Glyphosate is an antibiotic, killing some of the best bacteria in the human microbiome, including Bifidobacteria and Lactobacillus (4). A 2014 study published in Cell showed that merely eradicating four of those types of bacteria—Lactobacillus, Allobaculum, Rikenellacae, and Candidatus Arthromitus—caused obesity in lab animals.

A study, on three food microorganisms (Geotrichum candidum, Lactococcus lactis subsp. cremoris and Lactobacillus delbrueckii subsp. bulgaricus) widely used as starters in traditional and industrial dairy technologies, published in Current Microbiology (26), showed that glyphosate kills bacteria even at the incredibly tiny concentration of one part per million.

According to a 2009 study published in Toxicology, glyphosate has been shown to be an endocrine disrupter in human cells. Glyphosate changes human cell permeability, induces human breast cancer cell growth via estrogen receptors, amplifies toxicity and accelerates cell proliferation at tiny concentrations (measured in parts per billion to parts per trillion). Cytotoxic effects started at 10 ppm, and DNA damages at 5 ppm. A real cell impact of glyphosate-based herbicides residues in food, feed or in the environment has to be considered, and their classifications as carcinogens/mutagens/reprotoxics is discussed(27).

It has been demonstrated that glyphosate formulations induce apoptosis (cell suicide) and necrosis (cell death) in human umbilical, embryonic, and placental cells. The dilution level used in the study is far below agricultural recommendations and corresponds to low levels of residues in human food and animal feed (28).

Stephanie Seneff, a senior researcher at the Massachusetts Institute of Technology, published a paper suggesting that glyphosate may explain the link between a damaged microbiome and gluten intolerance (31).

Bt toxin dissolves in the gut of the insect, attacks its gut cells, creates holes in the lining, and causes death within a couple of days.

Start with avoiding the 'Dirty Dozen' found at the Environmental Working Group web site.

http://www.ewg.org/foodnews/summary.php This list is updated annually.

The Non-GMO Project lists the following crops in commercial production as "high-risk." The percentages reflect how much of these crops contains GMO. Alfalfa (no precise data), Canola (90% of US crop), Corn (93% of US crop), Papaya (most of Hawaiian crop; no precise data), Soy (94% of US crop), Sugar beets (99% of US crop), Zucchini and yellow summer squash (no precise data). The Non-GMO Project is a nonprofit organization that offers third-party verification and labeling for non-GMO food and products. The project has rigorous standards, which includes ongoing testing of all at-risk ingredients.

Common ingredients derived from GMO risk crops: Amino acids, Aspartame, Ascorbic acid, Sodium ascorbate, Vitamin C, Citric acid, Sodium citrate, Ethanol, Flavourings (“natural”and “artificial”), High-fructose corn syrup, Hydrolyzed vegetable protein, Lactic acid, Maltodextrins, Molasses, Monosodium glutamate, Sucrose, Textured vegetable protein (TVP), Xanthan gum, Vitamins.

Corn and soy derived foods to buy organic are foods that stem from soybeans like: Edamame, Tofu, Tempeh, Tamari, Soy nuts, Soy sauce, Soy flour, Soy protein powder, Veggie hot dogs or burgers, Some processed deli meats, Miso, Soy cheese, Soy mayonnaise, Soy milk.

Corn-sourced products to buy organic or avoid completely are: Baking powder, Corn meal, Corn syrup, Tortillas, Corn chips, Polenta, Popcorn, Cereal, Animal feed, Livestock feed, Whiskey, Sugar, Xanthan gum.

Fish Farms and Feedlots

Conventional animal and fish protein raised on antibiotics and GMO grains alters their own gut flora/fauna and makes a poor quality meat/egg/milk products for consumption.

Pre-Packaged Meals

Processed foods lack fibre, are made with refined sugar, toxic fats, low quality ingredients and are nutrient deficient because they have been grown using conventional farm practices, in soil that has been poorly managed.

Additives & Emulsifiers

Additives and emulsifiers — ingredients like lecithin, carrageen, guar gum, Datem, CMC and polysorbate 80. These compounds may damage the lining of the gut wall leading to leakage and inflammation.

Chapter Seven

Whole Foods To Embrace

Reshaping the Gut Biome

Several clinical and experimental studies have shown that a whole foods diet is one of consistent and predictable ways of reshaping the gut microbiome (3).

Unpasteurized Fermented & Cultured Foods

Unpasteurized fermented and cultured food examples: brine pickles and vegetables, rice miso, sauerkraut, kimchi, water keifer, kombucha, traditional cured Greek olives, raw apple cider vinegar. These items provide prebiotic food for gut bacteria, as well as, a new shipment of transient bacteria for gut biome diversity.

Bitters

Liver stimulants (bitters), examples:, barberry, chamomile, dandelion, goldenseal, turmeric, cardamom, lemon peel, yarrow. Used to promote the flow of bile. A short course of herbal bitters may enhance immune response against infection by supporting an optimal environment for helpful microbes (23).

Stomach Acid Supporters

Stomach acid supporters, examples: apple cider vinegar, lemon juice + water, baking soda + water, These mixtures help to maintain optimal stomach acid secretion levels which in turn supports an intestinal environment for helpful gut bacteria (22).

Demulcents

Demulcents examples: plantain seeds, chia seeds, flax seeds, slippery elm, cooked oatmeal, When mixed with water they form a soothing protective film onto a mucous membrane (epithelial) surface, (19)

Intestinal Lining Supporters

Intestinal lining supporters, examples: bovine bone broth, collagen, gelatine from grass fed and pasture raised animals (8)

Detoxifiers

Detoxifiers, examples: cruciferous vegetables like cabbage, kale, mustard greens, broccoli. These foods have metabolites, which are broken down by gut microbes to release substances that reduce inflammation (21)

Medicinal Teas

Medicinal teas, examples: reishi & chaga, Both of these mushrooms have bioactive compounds which have been shown to reduce gut inflammation(16)

Herbs

Herbs, examples: peppermint, parsley, chamomile, oregano, thyme, tarragon, coriander have essential oils and phytonutrients that inhibit pathogens and support gut biome balance.

Breast Milk

Breast milk, nature's most perfect food for newborn babies and for inoculating new gut biomes (2).

Prebiotic Food

Prebiotic food grown in local soil with organic or permaculture practices, examples: asparagus, burdock root, endive, garlic, dandelion greens, leeks, onions, mushrooms. These foods are mostly fiber that gut bacteria consume, producing beneficial byproducts for gut health, (18)

Chapter Eight

Conclusion

Probiotics and prebiotics may have the potential to be long term effective therapies to alleviate the symptoms associated with inflammatory diseases; however, the long term effects are currently unknown. As the understanding of the microbiota continues to grow, promoting microbes which can prevent or control inflammatory mediated diseases through diet may represent a therapeutic avenue (1).

We depend on microbes, and so should do our best to align their interests with ours, mainly by feeding them the kinds of things they like to eat — good "substrate." But absolute control of the process is too much to hope for. It's a lot more like gardening than governing. The successful gardener has always known you don't need to master the science of the soil, which is yet another hotbed of microbial fermentation, in order to nourish and nurture it. You just need to know what it likes to eat — basically, organic matter. The gardener also discovers that, when pathogens or pests appear, chemical interventions "work," that is, solve the immediate problem, but at a cost to the long-term health of the soil and the whole garden. The drive for absolute control leads to unanticipated forms of disorder (20).

The human-microbial super organism is a vast ecological system, subject to the same rules of resistance, resilience and balance as any ecosystem on the planet. What should we be aiming

for? The answer is likely different for different age groups and populations. At the least, shoot for 30-50 plants a week, and reduce the processing - let your stomach and guts do the work, they were designed for, most of the time.

To riff on a famous Michael Pollen quote:

Eat dirt, not too much, mainly with plants, preferably some of them fermented.

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