Stress, Mood, Immunity and the Gut

What happens in the gut is critical to how we feel, how we respond to stress, and even how much and what kinds of foods we eat. A vast sensory organ, the gut contains the enteric nervous system or second brain and the largest collection of immune and endocrine cells in the body. It is also home to more than 100 trillion microbes. “The microbial components are vastly greater than our human aspect.” The microbiome in the gut is sometimes called the forgotten organ because it affects so many systems and functions and rivals the brain in its complexity.

The gut-brain-microbiome axis

There is an ongoing dialogue between all components of the gut and the brain. Messages from the endocrine and neural cells lining the gut and the microbes in the colon are transmitted to the brain via the vagus nerve and the blood stream.

This informational highway is filled with neurotransmitters, hormones, cytokines (secreted by immune cells) and metabolites (produced by the microbes) communicating through a sophisticated biochemical language.

Although the brain is often viewed as a director, it more often listens and responds to the gut. Most of the day to day responsibilities are delegated to the Enteric Nervous System. “As with any cooperative arrangement, healthy communication is essential.” Disturbances of the conversation can lead to digestive disorders, mood imbalances, and compromised immunity. (Emeran Mayer: The Mind-Gut Connection)

Through a shared biological language, the microbes in our gut connect us to the earth’s web of life –the microbiomes in the soil, the air and the oceans. While the gut bacteria influence our inner weather – our moods, behavior and health, these other bacterial systems influence our outer weather.

“Plants and soil microorganisms shuttle atmospheric carbon back into deep storage in the earth; phytoplankton in the ocean help regulate the temperature and oxygen concentration on the planet; bacteria that ride around in the clouds help raindrops and snowflakes to form.” (Didi Pershouse: The Ecology of Care).

The massive use of antibiotics is disrupting ecological systems both within us and without and diminishing microbial diversity.

To enhance our microbiome, the usual recommendations are to consume prebiotics, probiotics, and fermented foods. All of these are helpful. As herbalists we have additional resources to bring to the healing of our gut bacteria and digestive system. Here is some information about the biology of the gut and the materia medica that can help address digestive, mood and immune imbalances.

What do microbes do?

In exchange for a constant supply of food, moderate temperatures and free travel, the microbiota in our gut provide us with essential vitamins and bile acids. They digest dietary fiber and complex sugars that our digestive system cannot break down and produce metabolites, neurotransmitters and hormones that transmit messages to the brain. Gut microbes also regulate the immune system and prevent the growth of dangerous pathogens. This ancient contract has produced a mutually beneficial co-existence which is now being imperiled.

So, what disturbs the microbiota and the gut-brain axis?

The disruptors are chronic stress, a diet filled with excessive sugar, toxic fats, artificial sweeteners (which increase blood sugar levels and generate inflammation), and food emulsifiers (which negatively impact the microbiota and damage the protective mucous layer in the gut) along with residues of antibiotics found in conventionally raised animals and in the environment (antibiotics have a long half-life). Most likely, pesticides used to grow GMO foods are also toxic to the microbiome. These disruptions are reprogramming the gut-brain-microbiome leading to higher levels of inflammation, leaky gut, and increased permeability of the blood/brain barrier.

A healthy microbiome is diverse. "Researchers now speak of an impoverished "Westernized microbiome" and ask whether the time has come to embark on a project of "restoration ecology" — not in the rain forest or on the prairie but right here at home, in the human gut." (Justin Sonnenburg, author of The Good Gut")

How to improve gut function.

Consuming prebiotic, probiotic and fermented foods is the standard advice for enhancing microbial diversity. Researchers are now exploring the potential of supplementing with "psychobiotics" – probiotics designed to improve mental health. Some animal and human studies are promising, but there is a growing recognition that the microbes thrive in an ecologically balanced gut.

Prebiotics are complex carbohydrates – dietary fiber that are not absorbed or metabolized by our own intestinal cells and therefore provide nourishment to the gut bacteria.

Inulin, a commonly available prebiotic, is found in many fruits and vegetables including bananas, chicory root, dandelion greens, garlic, onions, leeks and tubers such as Jerusalem artichoke. Bacteria in the colon ferment inulin and produce short term fatty acids which can protect our gut from inflammation.

We also have wonderful herbal prebiotics some of which also soothe irritation in the gut lining.

(Slippery Elm. (Ulmus rubra) Use only a small amount since it is endangered.

Marshmallow, chamomile, dandelion, burdock, and licorice can be dried and powdered to produce a powerful and delicious prebiotic combination. Plantain and elecampane also have prebiotic actions.

There are many probiotics on the market, some of which do not have much value. I like Dr. Ohhira's Professional formula and have heard positive reports about Osumex. We can also improve the health of the microbiota with fermented vegetables and dairy – sauerkraut, fermented beets, kimchi and high quality yogurts etc. Sandor Katz has written a number of wonderful books, including "The Art of Fermentation" with guidelines on how to ferment food.

These approaches are helpful but not sufficient. For the microbiota to flourish, we need to reduce stress and eliminate stagnation and inflammation in the gut.

Polyphenols:

Polyphenols are natural compounds that reduce inflammation, protect the heart, promote brain health and support normal blood sugar and blood pressure levels. They also give fruits, berries, and vegetables their vibrant colors, and contribute to the bitterness, astringency, and aroma of plants.

Polyphenols have prebiotic activity, since they increase the healthy bacteria in the gut (such as Lactobacillus and Bifidobacteria strains) and inhibit the growth of harmful bacteria. They include fruits such as purple grapes, red cherries, dark berries, vegetables such as red cabbage, broccoli, spinach, and red onion along with tea, dark chocolate, red wine and olive oil.

Among the medicinal plants that contain polyphenols are a wide variety of culinary herbs with carminative properties: Coriander, dill, rosemary, sage, cinnamon, coriander, ginger, nutmeg, turmeric and thyme. (

Polyphenols are also found in herbs that help support the digestive and nervous systems. They are either bitter or sweet and include meadowsweet, skullcap, lemon balm, chamomile and marshmallow, among others.

Bitters

To improve the general functioning of the gut, we need bitters. Recent research indicates that the bitter and sweet taste receptors found on our tongue are also distributed throughout the gastrointestinal tract.

There are twenty-five receptors in our gut for the bitter taste. These receptors have little or nothing to do with our taste experience. They are located on sensory nerve endings on endocrine cells embedded in the gut wall, a prime location to participate in the gut-brain dialogue and regulate the release of hormones. Some of these receptors are activated by specific molecules found in herbs and spices.

Bitters are known to be cooling and drying and move the energy downward. They reduce inflammation throughout the body and are specific for those who have too much heat or who are too damp – edemas, cysts, diarrhea, and excessive perspiration. Bitters promote digestion by stimulating secretion of salivary enzymes, hydrochloric acid, bile and pancreatic enzymes. They also reduce excessive craving for sweets by balancing blood sugar levels. Finally, they help sedate the nervous system.

Some bitter digestive herbs: artichoke, gentian, dandelion, goldenseal. Bitter nervines: skullcap, lemon balm, St. Johnswort, wild lettuce and blue vervain. Bitter formulas often include a pungent herb that is warming and helps break up stagnation in the digestive tract.

We will discuss chocolate as a bitter and will sample delicious chocolate digestive and mood balancing bitter formulas.

The Sweet taste

When we consume carbohydrates, sweet taste receptors in the gut stimulate the absorption of glucose into the blood stream and signal the release of insulin from the pancreas. Insulin guides the blood sugar into the cells.

The sweet taste is soothing, moistening, and strengthening. It is also relaxing to the nerves and building of tissue. Consuming too many sweets causes

inflammation and weakening of the digestive system. Sweet herbs include marshmallow, licorice, codonopsis and astragalus.

Regulation of Appetite

Receptors for the bitter and sweet tastes secrete hormones that help to regulate appetite. Sweet taste receptors stimulate a hormone called PYY that binds to receptors on the hypothalamus to signal satiety – the need to stop eating. Fat cells secrete leptin, another appetite reducing hormone that regulates the sweet taste receptors and lowers cravings for sweets. Leptin also signals the hypothalamus to lower appetite. Inflammation in the gut is another cause for appetite dysregulation.

Bitter taste receptors stimulate the release of ghrelin which enhances appetite. Appetite reducing hormones such as PYY and leptin have an inverse relationship to ghrelin. Overconsuming sweets can lead to leptin resistance, so that we do not receive signals from the hypothalamus that we are full.

Carminatives

Carminatives clear up gas and bloating by bringing aromatic oils to the intestines. They also reduce spasms by bringing circulating blood to warm and soothe the intestines. Many carminative herbs also have polyphenols that support the microbiota and reduce inflammation.

Carminatives include peppermint leaf, chamomile, cardamom seed, fennel seed, ginger root, and dill seed.

Gas or belching or sleepiness immediately after a meal or one half hour after suggests hydrochloric acid deficiency. Gas after one or one and a half hours suggests overgrowth of pathogenic bacteria in the intestines. Gas with diarrhea and/or constipation might indicate overgrowth of intestinal yeast (Candida). Persistent symptoms of this sort are usually labeled Irritable Bowel Syndrome.

Tea tasting: Lemon balm, meadowsweet, chamomile, spearmint and licorice.

Gut problems and mental health issues often coincide.

Microbes and their metabolites may play an important role in the development of depression. Gut bacteria transmit messages to the brain that can influence memory, mood and behavior. They produce neurotransmitters (serotonin, dopamine and gaba) that are sent via the vagus nerve to receptors in the limbic

area of the brain associated with memory, emotion, thinking and appetite regulation.

According to some recent research, the gut microbiota may also play an important role in the modulation of REM sleep and dream states. (Emeran Mayer)

Researchers have also identified two strains of bacteria that are lacking in the guts of people who have been diagnosed with depression. (A study in *Nature Microbiology* indicates that clinical depression could be affected by the amounts of certain bacteria in the gut. The research team was led by microbiologist Jeroen Raes of the Catholic University of Leuven in Belgium).

Serotonin

Ninety five percent of the body's serotonin is found in the gut. **Serotonin containing cells in the gut are influenced by what we eat, by chemicals released by certain species of gut microbes and by signals from the brain. These serotonin containing cells form part of the gut-brain axis, sending messages directly to the emotional centers of the brain.**

Serotonin is the ultimate gut-brain signaling molecule helping to regulate peristalsis as well as mood.

The gut has seven different receptors for serotonin which are impacted by psychotropic medications such as the SSRI's. These medications initially cause serotonin receptors to be overstimulated leading to diarrhea. After a period of time, the receptors become resistant to serotonin leading to sluggish peristalsis and constipation.

Supporting the health of the microbiome may help reduce the incidence of neurodegenerative diseases such as Parkinson's, MS and even Alzheimer's. Shifts in the gut microbiota and in certain nerves in the enteric nervous system occur years before the onset of neurological symptoms in people with Parkinson's disease. Sluggish peristalsis and constipation also appear before other symptoms.

There is speculation that Parkinson's and other neurological diseases are gut-brain disorders and may be addressed in the very early stages by healing the gut.

To enhance mood and reduce anxiety, we need to consider nervines to calm and enliven neural tissue, prebiotics, probiotics and fermented foods to support the microbiota, along with a non-inflammatory diet, and exercise. We may also need herbs to reduce inflammation and congestion and possibly combat parasite and candida overgrowth. Leaky gut leads to inflammation and disturbances of digestion and mood as do food sensitivities.

Over millennia, our gut sensors have evolved to encode a number of nutritional and medicinal plant signals. These signals are communicated to the enteric nervous system and the brain and have an effect on our digestion and how we feel.

Some helpful nervines include skullcap, blue vervain, milky oats, linden, passionflower, lemon balm, wood betony, motherwort, and wild lettuce. Many of these herbs are also bitter (skullcap, blue vervain, motherwort and wild lettuce) and some like milky oats have a sweet taste. Most are anti-inflammatory and some are carminative and have polyphenols. Along with supporting the nervous system, these herbs are also enhancing the ecology of the gut.

Just as the gut influences the brain, the reverse is true. “The gut mirrors every emotion that arises in the brain.” There is a coordinated physical response in the gut to every emotion we feel. In fact, each emotion has its own characteristic pattern of gut contractions, blood flow and secretion of digestive enzymes. (Emeran Mayer)

Negative emotions can increase sensitivity in the gut leading to changes in peristalsis – a slowing down or lack of intestinal activity with depression and anxiety and contractions in the stomach and colon with chronic anger.

Chronic stress also leads to changes in the enteric nervous system and microbiota. Sensors in the gut become more sensitive and gut microbes become more aggressive. Negative emotional states also reduce beneficial bacteria in the gut (lactobacillis and bificobacteria).

Stress, the Microbiome and the HPA

Gut bacteria appear to regulate the set point (baseline) for the HPA axis – the hypothalamus-pituitary-adrenal axis, which regulates our response to stress. What this means is that microbes help to regulate how we respond to challenges in the environment.

Conversely, chronic stress can trigger an inflammatory cascade that impacts microbial health and digestive function. Chronic stress disrupts the gut-microbiome-brain axis triggering the endocrine cells in the gut to release a stress hormone (noradrenalin).

Adaptogenic herbs help modulate stress, reduce inflammation, enhance immunity and, since many of them are bitter, they can also improve digestion. Some recommended adaptogenic herbs: Eleuthero, licorice, condonopsis, holy basil, ashwagandha, American ginseng, reishi, nettle.

The Microbiome and the Immune System

Summary: Immune cells in the gut are the largest component of the immune system. When activated, they produce cytokines, messenger molecules that signal the brain via the vagus nerve. Like hormones, they also travel through the blood to reach the brain. Leaky gut and an overgrowth of candida, parasites and pathogenic bacteria can elicit an immune response which, if chronic, can lead to low grade inflammation throughout the body and permeability of the brain/brain barrier.

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