AllClear
HEALTHCARE

INFORMATION ABOUT OUR BREATH TESTING

Breath Testing for hydrogen and methane has been used for decades in the diagnosis of digestive disorders of carbohydrate absorption, and more recently for small intestinal bacterial overgrowth (SIBO). They are based on the principle that when bacteria (in the intestine) digest carbohydrates (sugars, starches or vegetable fibers), they produce CO2 (as all other cells do) and hydrogen (H2) as well as methane (CH4). Some bacteria also produce hydrogen sulfide (H2S) but the clinical significance of this is still under investigation, and measurement of this gas has not yet a firmly established role in diagnostics. These gases get absorbed into the bloodstream and are exhaled, paving the way for end-expiratory analysis of breath samples for the diagnosis of associated disorders. When either hydrogen or methane appear in the exhaled air, it is a sign that such carbohydrates have been exposed to bacterial metabolism.

Since absorption of glucose and fructose, as well as the disaccharides lactose and sucrose (after enzymatic splitting) occur in the small intestine, where bacteria are ordinarily not present in significant numbers, these absorptive processes do not lead to a significant rise in hydrogen or methane in breath samples of normal individuals. If, however, absorption is impaired, the unadulterated sugars reach the colon, are fermented and the hydrogen/methane production is significantly increased. The same holds true if there are abnormally high bacterial counts in the small bowel.

Some patients produce more hydrogen, some others more methane, in part because their bowel flora contains more methanogenic bacterial strains that convert hydrogen to methane. Measuring hydrogen alone (older breath-test analyzers) would therefore miss such patients, increasing the false negative test result rate.

Our Technology

We utilize state-of-the-art gas chromatography analyzers that measure both hydrogen and methane concentrations very precisely and accurately. The analyzer also measures the CO2 concentration in the breath sample and applies a correction factor to the measured hydrogen and methane values to normalize these to a standardized CO2 concentration – and therefore adjust for potential variations of gas concentrations during sampling. This is necessary because during the breath cycle CO2 concentrations (and those of the other gases) vary, due to potential mixing with air in the dead space/room air). In alveolar air the "normal" concentration of CO2 is around 5.5.% (equivalent to 40 mm Hg partial pressure) at sea level – and our machines are calibrated with this value to account and correct for improper sampling variations. Our analyzers are regularly calibrated with standardized gas mixtures to assure quality of analysis.

All our technicians are trained by a board-certified gastroenterologist in the on-site sampling technique, performance of the analysis and in the interpretation of the test results. Results are also submitted to the gastroenterologist for review to assure correct interpretation. The customer receives the results from our company and can of course share them with a provider of their choice. Because of HIPAA regulations we will not regularly share results with providers directly, except if specific arrangements are made to comply with such regulations.

For our customers who choose to do the sampling in the comfort of their home, (and mail in their sample) they will receive a complete sampling kit with detailed instructions, including a video explaining the sampling technique, and return-mail supplies. The samples are then processed in our facility using the system that assures accurate sample processing in the same analyzers used for our in-house samples.

The most common application of these breath tests is for the diagnosis of Lactose Intolerance. This is a very common condition, not only in various ethnic groups, but also in older age, and associated with other illnesses (Celiac disease, Diabetes mellitus etc.).

More recently, SIBO has received a lot of attention – and is considered relatively common in patients after antibiotic therapy, after intestinal surgery, or as a result of medical therapies for a variety of conditions (e.g., acid reflux treatment etc.). It also seems to be associated with diseases that lead to gut motility problems or alter the intestinal environment, e.g., Scleroderma, Diabetes (especially with neuropathy, gastroparesis etc.), Hypothyroidism, Inflammatory bowel disease, Diverticulosis and many others.

Other disorders that can be diagnosed by breath testing are less well known, but are nevertheless rather common contributors to common GI-symptoms:

- Fructose Malabsorption
- Sorbitol Sensitivity

>> Patients with these sensitivities may in fact be erroneously lumped into having a diagnosis of irritable bowel syndrome, rather than having a specific and treatable diagnosis of their specific carbohydrate-related disorder.

Brief Overview of Fructose and Sorbitol

Fructose Malabsorption (or non-hereditary Fructose Intolerance)

Fructose malabsorption is fairly common, affecting up to 1 in 3 people. It is just as common in people with a diagnosis of irritable bowel syndrome as in the rest of the population, and symptoms are quite similar but generally triggered by intake of fructose – containing foods. In some cases, fructose malabsorption may be caused by diseases which cause intestinal damage, such as celiac disease.

Fructose malabsorption is not to be confused with "*hereditary fructose intolerance* (HFI)" a rare, potentially fatal condition in which the liver enzymes that break up fructose are deficient.
Fructose malabsorption may cause gastrointestinal symptoms such as abdominal pain, bloating, flatulence and diarrhea.

Fructose is absorbed in the small intestine without help of digestive enzymes. Even in healthy persons, however, only about 25–50 g of fructose per sitting can be properly absorbed. People with fructose malabsorption absorb less than 25 g per sitting. Simultaneous ingestion of fructose and sorbitol seems to increase the malabsorption of fructose. Fructose that has not been adequately absorbed is fermented by intestinal bacteria producing hydrogen, methane and carbon dioxide, as well as short-chain-fatty-acids. This abnormal increase in hydrogen may be detectable with the hydrogen and methane breath tests with fructose as a substrate.

As a result of fructose malabsorption, rapid bacterial fermentation in the small intestine occurs, leading to altered gastrointestinal motility (e.g., diarrhea), the formation of mucosal biofilms, and a change in the intestinal flora. These effects are additive if other poorly absorbed carbohydrates are present, such as sorbitol. The clinical significance of these events depends upon the individual susceptibility to such changes. There is also evidence that fructose malabsorption can cause decreased Tryptophan, Folic Acid and Zinc levels in the blood.

Restricting dietary intake of free fructose and/or fructans (longer sugars containing fructose) may provide symptom relief in a high proportion of patients with such functional gut disorders.
One must be careful with the results of the Fructose Breath Test, because a negative result does not completely rule out that a trial of fructose restriction may help the patient (in other words, the sensitivity of the test is relatively low), while a positive result is very specific that such a trial is useful.

Sorbitol Sensitivity

Sorbitol is a sugar alcohol that is found in many types of fruit and vegetables, where it serves as a precursor for sugar synthesis. We consume it in small quantities with our food all the time. This substance belongs to the group of FODMAPs (FODMAP stands for fermentable oligosaccharides, disaccharides, monosaccharides and polyols, which are short-chain carbohydrates (sugars) that the small intestine absorbs poorly.), i.e., carbohydrates that are poorly absorbed by the body. Because it usually only occurs in small amounts in natural food, our intestinal system is naturally not prepared to digest high quantities of sorbitol. Most sugar alcohols like sorbitol have a highly laxative effect even for healthy people – with doses of 20-50 grams most people will develop diarrhea. However, if you experience digestive problems after consuming only a few grams, you might suffer from sorbitol sensitivity or intolerance.

The problem is much larger than meets the surface, given that sorbitol and other sugar alcohols are commonly used in the food industry, since they absorb water and thus prevent the dehydration of packaged food. This is how products like packaged cakes stay fluffy and moist. The same ingredients also work as sugar replacements in diabetic and some sugar-free or sugar-reduced foods, because they don't cause the blood sugar level to rise. Hence, these products are popular with diabetics and “weight watchers”.

Common natural foods containing sorbitol:
Apples, pears, apricots, plums, peaches cherries, dried fruit

Common processed foods containing significant amounts of sorbitol:
Chocolate, cream fillings, cough drops, chewing gum, gingerbread, packaged cakes (including cupcakes, muffins etc.), ice cream, chewy fruit candies, jams and marmalade, and many sugar-free products. Also, medications can contain some sorbitol.

Depending on the consumed dose, symptoms of intolerance can range from minor flatulence, belly ache and loose stools to severe diarrhea.

The reason for this lies in the hygroscopic (water-attracting) effect of sugar alcohols: If large amounts of undigested sugar alcohols reach the colon, they cause an unpleasant sequence of events. Sorbitol draws water from its environment, increasing the stool volume. The intestinal bacteria ferment the unabsorbed sorbitol, often producing harmful metabolic products and digestive gases, which further irritates the GI tract. The symptoms are quite similar to other carbohydrate malabsorptions, like lactose intolerance.

There are multiple studies that have shown sorbitol-induced nonspecific abdominal symptoms and diarrhea in a significant number of adults, with diabetics slightly more commonly afflicted than non-diabetics. In some studies, up to 20-35% of adults will develop symptoms after ingestion of only 10g of Sorbitol. These symptoms, when not properly diagnosed as sorbitol-intake-related, could lead to an extensive diagnostic work-up and a lifelong (erroneous) diagnosis of irritable bowel syndrome.

A Sorbitol Breath Test can diagnose this condition. -- The sorbitol breath test is easy to do and non-invasive, and there is generally a good correlation between the severity of symptoms and the amount of hydrogen/methane exhaled.

<u>One problem exists with proper interpretation, however:</u>
In some healthy people an intake of only 5 grams per day (that is the equivalent of 5 sugar-free candies or 4-5 sticks of sugar-free gum) can already lead to abnormalities (with a positive test and/or symptoms). Intake of 10 grams per day has been shown to produce positive test results in a significant number of people, with

symptoms in 20-35%. 20 grams cause abnormalities in over 80%. Nobody generally tolerates large amounts of sorbitol. **THEREFORE**: a positive test result on the breath test is only relevant if consumption of sorbitol-containing foods also leads to similar symptoms. The individual interpretation must be done in the context of the patient's symptoms and associated diet.

Regardless of the test result the patient should keep a detailed record of their diet and check if symptoms disappear by avoiding sorbitol. If that is not the case, the health care provider should reexamine the diagnosis and look for additional or other explanations. One possibility is that there is also fructose malabsorption. Since sorbitol in the intestine inhibits fructose uptake, the symptoms of sorbitol consumption can worsen if there is fructose malabsorption. In addition, the body converts sorbitol to fructose. Therefore, Fructose Breath Testing in addition to Sorbitol Breath Testing may be useful in some cases.