The Great Plains Laboratory, Inc.

Oxalate Control

Overview

The Organic Acids Test by The Great Plains Laboratory, Inc. is the only OAT on the market that evaluates levels of oxalates in urine. Oxalate (and its acid form, oxalic acid), is an organic acid that is primarily derived from three sources: the diet, fungus (such as Aspergillus and Penicillium), possibly Candida, and also human metabolism. Oxalic acid is the most acidic organic acid in body fluids and is used commercially to remove rust from car radiators. Antifreeze (ethylene glycol) is toxic primarily because it is converted to oxalate in the body. Two different types of genetic diseases are known in which oxalates are high in the urine, hyperoxalurias type I and type II, which can also be determined from the Organic Acids Test.

Foods especially high in oxalates are often foods thought to be otherwise healthy, including spinach, beets, chocolate, peanuts, wheat bran, tea, cashews, pecans, almonds, berries, and many others. People now frequently consume "green smoothies" in an effort to eat "clean" and get healthy, however, they may actually be sabotaging their health. The most common components of green smoothies are spinach, kale, Swiss chard, and arugula, all of which are loaded with oxalates. These smoothies also often contain berries or almonds, which have high amounts of oxalates as well. Oxalates are not found in meat or fish at significant concentrations. Daily adult oxalate intake is usually 80-120 mg/d. A single green smoothie with two cups of spinach contains about 1,500 mg of oxalate, a potentially lethal dose.

The Dangers of Oxalates

High oxalates in the urine and plasma were first found in people who were susceptible to kidney stones. Many kidney stones are composed of calcium oxalate. Stones can range in size from the diameter of a grain of rice to the width of a golf ball. It is estimated that 10% of males may have kidney stones some time in their life. Because many kidney stones contain calcium, some people with kidney stones think they should avoid calcium supplements. However, the opposite is true. When calcium is taken with foods that are high in oxalates, oxalic acid in the intestine combines with calcium to form insoluble calcium oxalate crystals that are eliminated in the stool. This form of oxalate cannot be absorbed into the body. When calcium is low in the diet, oxalic acid is soluble in the liquid portion of the contents of the intestine (called chyme) and is readily absorbed from the intestine into the bloodstream. If oxalic acid is very high in the blood being filtered by the kidney, it may combine with calcium to form crystals that may block urine flow and cause severe pain.

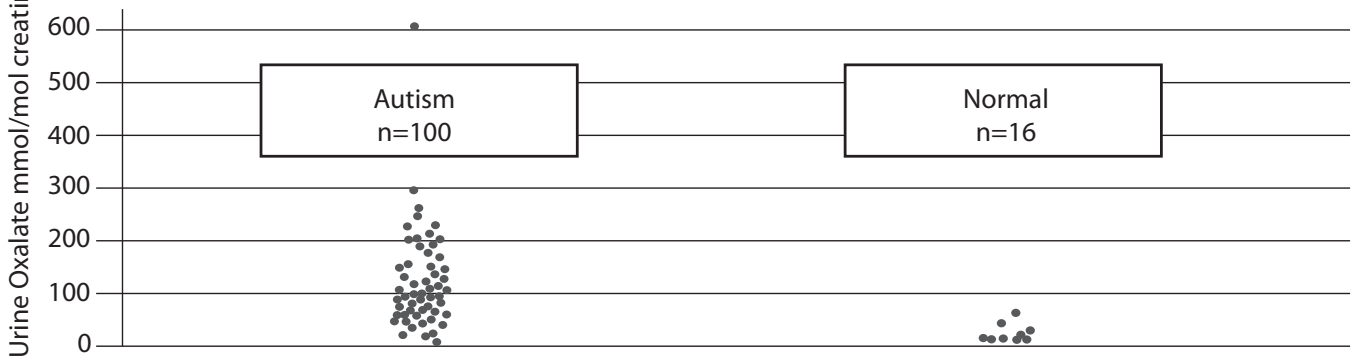
In addition to kidney disease, individuals with fibromyalgia and women with vulvar pain (vulvodynia) may suffer from the effects of excess oxalates. Oxalate crystals may also form in the bones, joints, blood vessels, lungs, thyroid, and even the brain, possibly impeding their proper function. In addition, oxalates in the bone may crowd out the bone marrow cells, leading to anemia and immunosuppression. Oxalate crystals cause pain and damage to various tissues, due to their sharp, physical structure, and may also increase inflammation. Iron oxalate crystals may cause significant oxidative damage and diminish iron stores needed for red blood cell formation. Oxalates may also function as chelating agents and may chelate many toxic metals, such as mercury and lead. Unlike other chelating agents, oxalates trap heavy metals in the tissues, leading to metal toxicity. Oxalates also interfere with the Krebs cycle's glucose metabolism and can inhibit absorption of essential minerals necessary for optimum health.

Oxalates and Autism

Studies show that oxalates in the urine are much higher in individuals with autism than in non-autistic children. In the figure below, it shows that 36% of the children on the autism spectrum had values higher than 90 mmol/mol creatinine, the value consistent with a diagnosis of genetic hyperoxalurias, while none of the non-autistic children had values this high. 84% of the children on the autism spectrum had oxalate values outside the normal range (mean ± 2 sd). None of the children on the autistic spectrum had elevations of the other organic acids associated with genetic diseases of oxalate metabolism, indicating that oxalates are high due to external sources.

A low-oxalate diet is being used extensively to treat children with autism and other disorders. Researcher, Susan Owens discovered that the use of a diet low in oxalates markedly reduced symptoms in children with autism and PDD. For example, the mother of an autistic son reported that he became more focused and calm, that he played better, that he walked better, and had a reduction in leg and feet pain after being on a low oxalate diet. Prior to the diet, her child could hardly walk up the stairs. After the diet, he walked up the stairs very easily. Many children with autism throughout the world are now being placed on this diet with good results.

Figure 1. Comparison of urine oxalate values of children with autism and normal children.



Oxalate Metabolism

In the genetic disease hyperoxaluria type I and in vitamin B-6 deficiency, there is a deficiency in the enzyme activity of alanine glyoxylate amino transferase (AGT), leading to the accumulation of glyoxylic acid. The high glyoxylic acid can then be converted to glycolate by the enzyme GRHPR or to oxalate by the enzyme LDH. Thus, glycolate, glyoxylate, and oxalate are the metabolites that are then elevated in the Organic Acids Test in hyperoxaluria type I and in vitamin B-6 deficiency.

In the genetic disease hyperoxaluria type II, there is a deficiency in an enzyme (GRHPR) that has two biochemical activities: glyoxylate reductase and hydroxypyruvic reductase. This enzyme converts glyoxylate to glycolate and glycerate to hydroxypyruvate. When this enzyme is deficient, glycerate cannot be converted to hydroxypyruvate and glyoxylate cannot be converted to glycolate. In this disease, glyoxylate is increasingly converted to oxalate and glycerate is also very elevated.

External sources of oxalates include ethylene glycol, the main component of antifreeze. Antifreeze is toxic mainly because of the oxalates formed from it. In addition, some foods also contain small amounts of ethylene glycol. Vitamin C (ascorbic acid or ascorbate) can be converted to oxalates but apparently the biochemical conversion system is saturated at low levels of vitamin C so that no additional oxalate is formed until very large doses (greater than 4 g per day) are consumed. It is interesting that fungi can also produce vitamin C which may explain why many children with autism have high vitamin C even though they do not take supplements containing vitamin C. The high correlation between arabinose and oxalates indicate that intestinal yeast/fungal overgrowth is likely the main cause for elevated oxalates in the autistic spectrum population. The deposition of oxalates in critical tissues such as brain and blood vessels, the oxidative damage caused by oxalate salts, and the deposition of oxalate mercury complexes in the tissues may all be important factors in the core etiology of autism.

How Can High Oxalates Be Treated?

- Implement a low-oxalate diet. This may be especially important if the individual has had Candida for long periods of time and there is high tissue oxalate buildup.
- Use antifungal drugs to reduce yeast and fungi that may be causing high oxalates. Children with autism frequently require years of antifungal treatment. Arabinose, a marker used for years for yeast/fungal overgrowth in the Organic Acids Test is correlated with high amounts of oxalates.
- Supplements of calcium and magnesium citrate can reduce oxalate absorption from the intestine. Citrate is the preferred calcium form to reduce oxalate because citrate also inhibits oxalate absorption from the intestinal tract.
- N-Acetyl glucosamine supplements can stimulate the production of the intercellular cement, hyaluronic acid, to reduce pain caused by oxalates.
- Chondroitin sulfate can prevent the formation of calcium oxalate crystals.
- Vitamin B6 is a cofactor for one of the enzymes that degrades oxalate in the body and has been shown to reduce oxalate production.
- Excessive fats in the diet may cause elevated oxalates if the fatty acids are poorly absorbed because of bile salt deficiency. If taurine is low, supplementation with taurine may help stimulate bile salt production (taurocholic acid), leading to better fatty acid absorption and diminished oxalate absorption.
- Probiotics may be very helpful in degrading oxalates in the intestine. Individuals with low amounts of oxalate-degrading bacteria are much more susceptible to kidney stones. Both Lactobacillus acidophilus and Bifidobacterium lactis have enzymes that degrade oxalates.
- Increase intake of essential omega-3 fatty acids, commonly found in fish oil and cod liver oil, which reduces oxalate problems. High amounts of the omega-6 fatty acid, arachidonic acid, are associated with increased oxalate problems. Meat from grain fed animals is high in arachidonic acid.
- Supplements of vitamin E, selenium, and arginine have been shown to reduce oxalate damage.
- Increase water intake to help eliminate oxalates.

High Oxalate Food List

Fruit	Vegetables		Drinks	Starch
Blackberries	Beans (baked, green, dried, kidney)	Potatoes (baked, boiled, fried)	Dark or "robust" beer	Amaranth
Blueberries	Beets	Rutabaga	Black tea	Buckwheat
Carambola	Beet greens	Spinach	Chocolate milk	Cereal (bran or high fiber)
Concord grapes	Beet root	Summer squash	Cocoa	Crisp bread (rye or wheat)
Currents	Carrots	Sweet potato	Instant coffee	Fruit cake
Dewberries	Celery	Swiss chard	Hot chocolate	Grits
Elderberries	Chicory	Zucchini	Ovaltine	Pretzels
Figs	Collards		Soy Drinks	Taro
Fruit cocktail	Dandelion greens			Wheat bran
Gooseberry	Eggplant	Fats, Nuts, Seeds	Dairy	Wheat germ
Kiwis	Escarole	Nuts	Chocolate milk	Whole wheat bread
Lemon peel	Kale	Nut butters	Soy cheese	Whole wheat flour
Orange peel	Leeks	Sesame seeds	Soy milk	
Raspberries	Okra	Tahini	Soy yogurt	Misc.
Rhubarb	Olives	Soy nuts		Chocolate
Canned strawberries	Parsley			
Tamarillo	Peppers (chili and green)			
Tangerines	Pokeweed			

Testing for Oxalates

The most convenient way of testing oxalates is by the Organic Acids Test (OAT) at The Great Plains Laboratory, Inc. The OAT checks for the presence of:

Oxalic acid (oxalates) - Tests for all forms of oxalic acid and its salts or conjugate bases.

Arabinose - Important Candida indicator which strongly correlates with oxalates.

Glycolic acid (glycolate) - Indicator of genetic disease of oxalate metabolism called Hyperoxaluria type I due to a deficiency in the enzyme activity of alanine glyoxylate amino transferase (AGT).

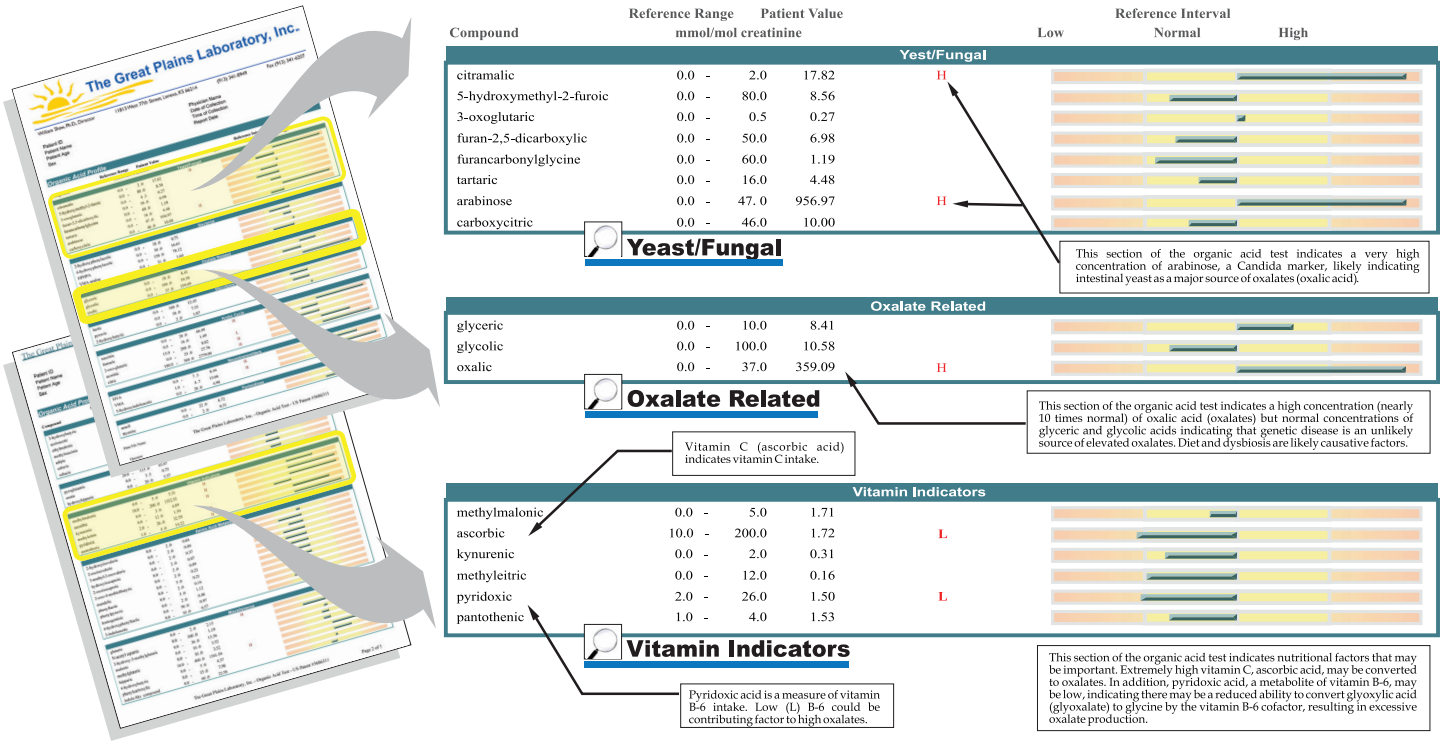
Glyceric acid (glycerate) - Indicator of genetic disease of oxalate metabolism called Hyperoxaluria type II due to a deficiency in an enzyme (GRHPR) that has two biochemical activities: glyoxylate reductase (GR) and hydroxypyruvic reductase (HPR).

Ascorbic acid (ascorbate, vitamin C) - Indicates nutritional intake of vitamin C and/or excessive destruction. Vitamin C can be excessively converted to oxalates when free copper is very high. Evaluate further with Copper/Zinc Profile from The Great Plains Laboratory, Inc.

Pyridoxic acid - Indicator of vitamin B-6 intake. The enzyme activity alanine glyoxylate amino transferase (AGT) requires vitamin B-6 to eliminate glyoxylic acid or glyoxylate, a major source of excess oxalates.

Furandicarboxylic acid, hydroxy-methylfuroic acid - Markers for fungi such as Aspergillus infection, one of the proven sources of oxalates.

Bacteria markers - A high amount of bacterial markers may indicate low values of beneficial bacteria such as Lactobacilli species that have the ability to destroy oxalates.



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