

The Great Plains Laboratory  
**GPL Academy**  
Practitioner Workshops

**BEYOND THE BASICS:**  
ADVANCED ORGANIC ACIDS TESTING STRATEGIES

**KURT WOELLER, DO**

Clinical Considerations of Elevated Oxalic Acid, Its Causes, and Intervention Strategies

1

The Great Plains Laboratory  
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**BEYOND THE BASICS:**  
ADVANCED ORGANIC ACIDS TESTING STRATEGIES

I, Kurt N. Woeller, DO, have the following commercial relationships to disclose:

- Founder of Integrative Medicine Academy
- Consultant for Great Plains Laboratory

2

## Disclaimer

- ▶ The material contained within this presentation is not intended to replace the services and/or medical advice of your personal licensed health care professional.
- ▶ This material is for educational purposes only
- ▶ This information is not meant to encourage diagnosis and treatment of disease.
- ▶ Any application of suggestions set forth in the following portions of this presentation is at the reader's discretion.
- ▶ Implementation and/or experimentation with any supplements, herbs, dietary changes, medications, and/or lifestyle changes, etc., is done so at your sole risk and responsibility.

3

3

## Lecture Overview

- ▶ What is oxalic acid (aka oxalate)?
- ▶ Tissue/organ damage examples
- ▶ The chemistry of oxalates
- ▶ Oxalate and heavy metals
- ▶ Treating high oxalates
- ▶ Supplement support for high oxalate
- ▶ Case example – high oxalate and chronic pain

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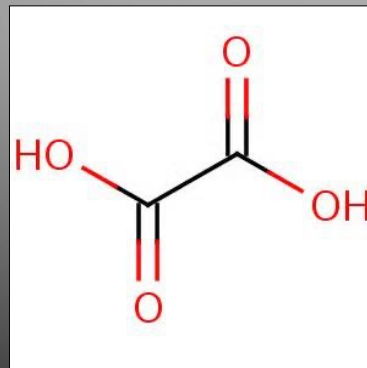
## What is Oxalic Acid?

- ▶ Oxalic (acid) is an organic acid obtained from 3 primary sources:
  - *Diet*
  - *Fungus, such as mold and yeast*
  - *Cell metabolism*
- ▶ Oxalic acid is the most acidic organic acid in body fluids
- ▶ Oxalic is often referred to as oxalate (the conjugate base of oxalic acid).
- ▶ Ethylene glycol (antifreeze) - primary toxicity effects are from oxalate crystal formation.

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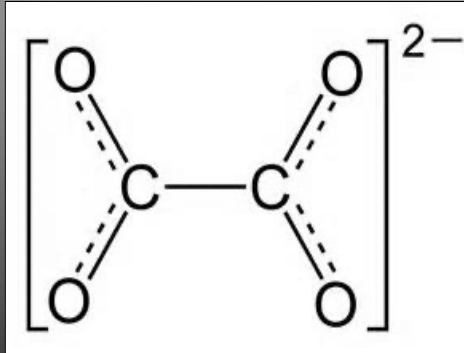
## Oxalic Acid



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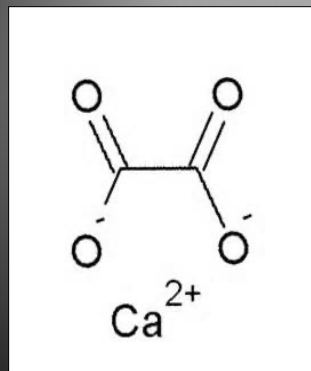
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## Oxalate Anion



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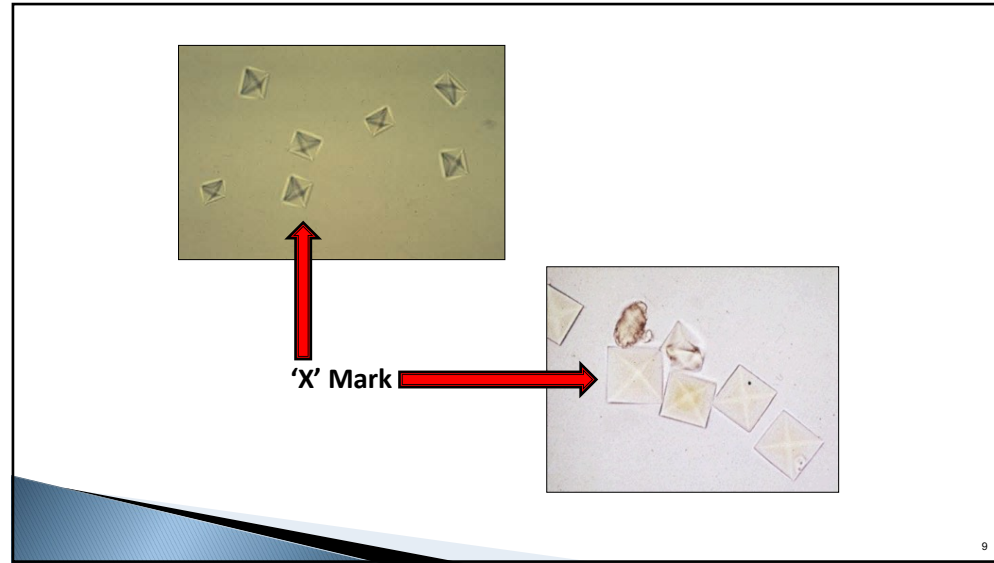
## Calcium Oxalate



### CALCIUM OXALATE CRYSTALS



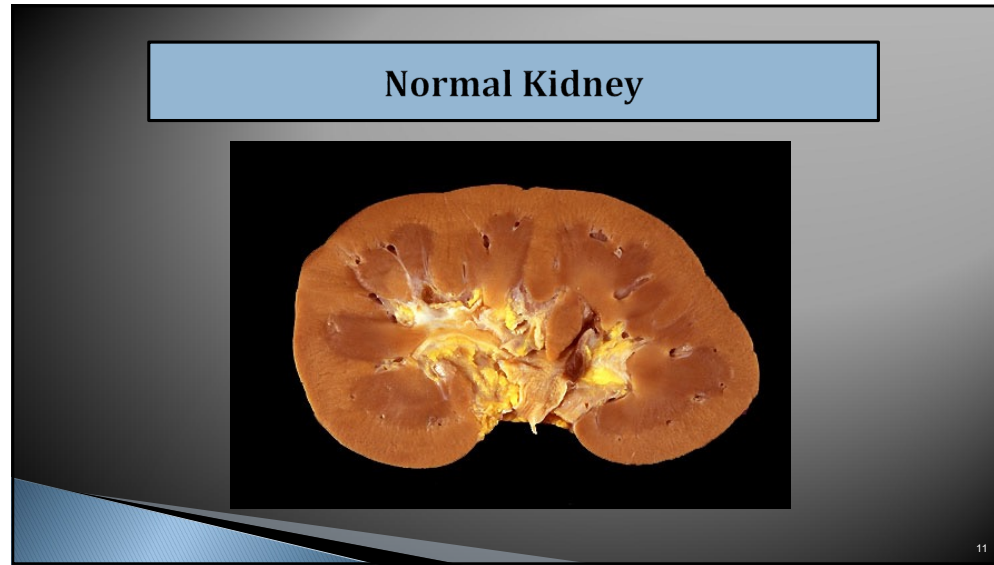
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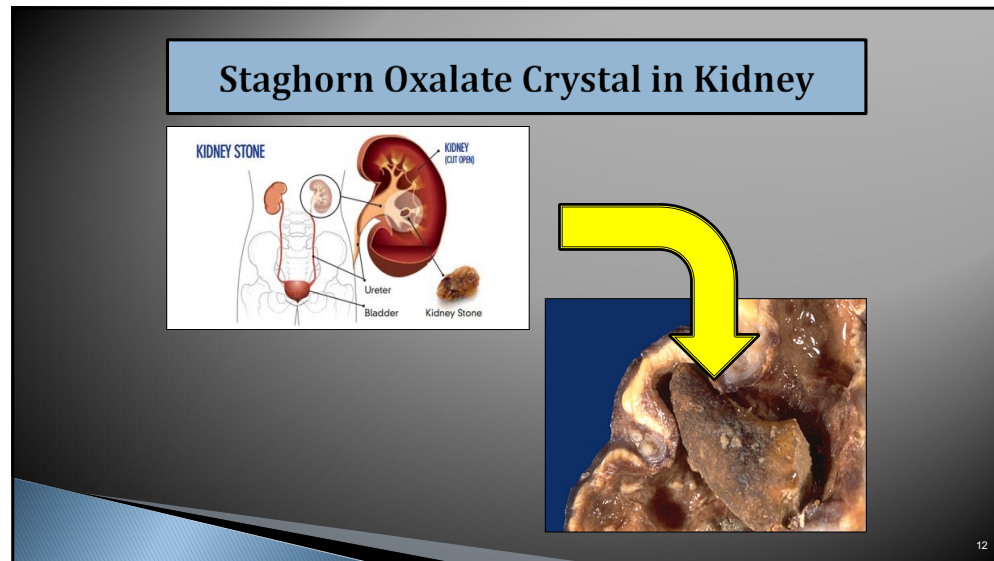
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**Tissue & Organ Damage  
From High Oxalate**

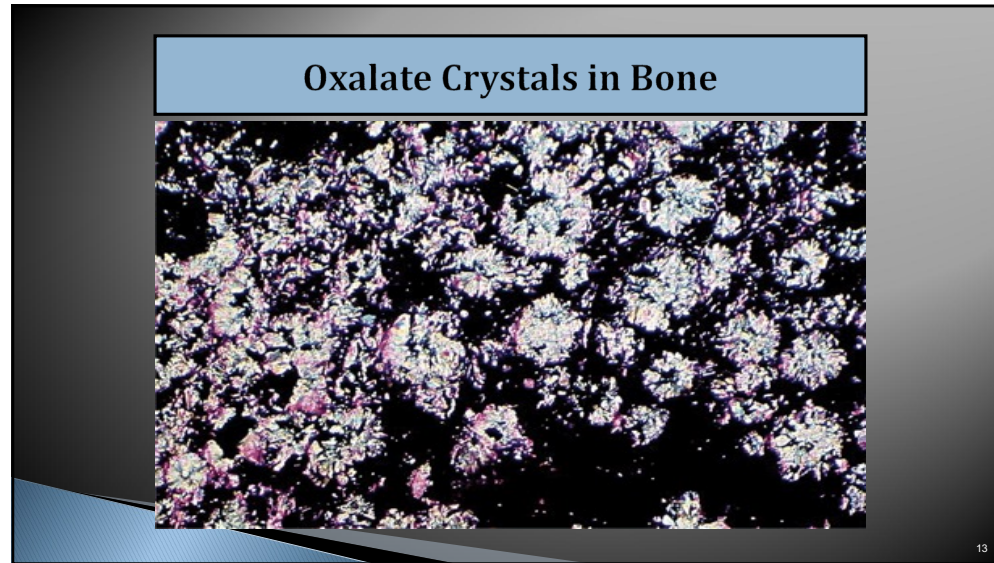
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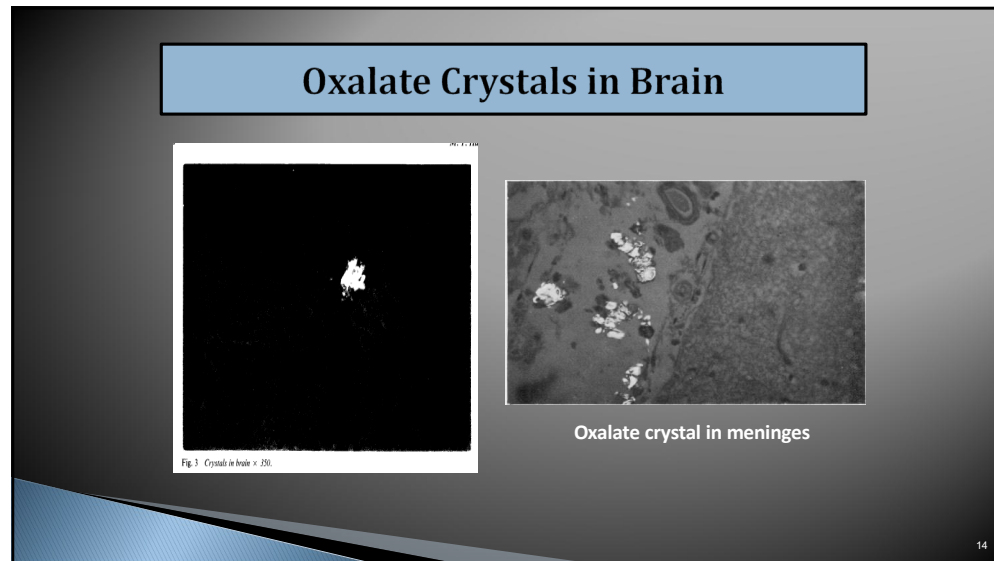
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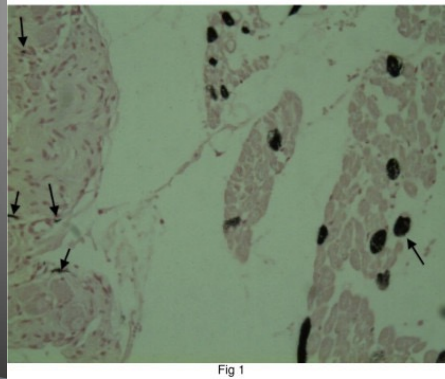


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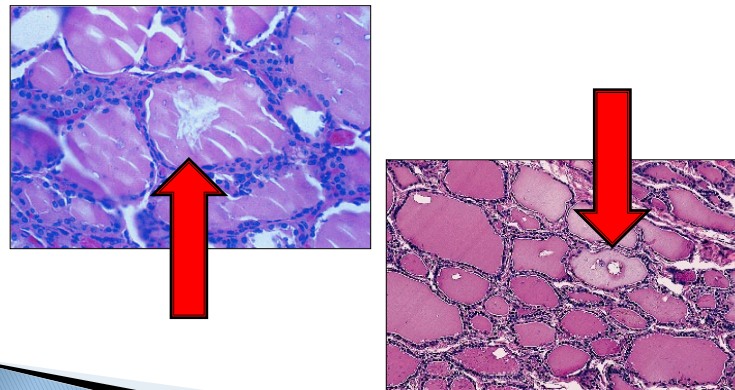
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### Oxalate Crystal in Nerve Tissue



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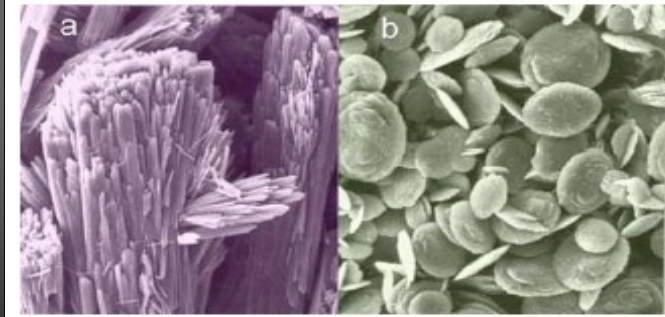
### Thyroid Oxalate Accumulation



16



## Oxalate Metal Complexes from *Aspergillus*

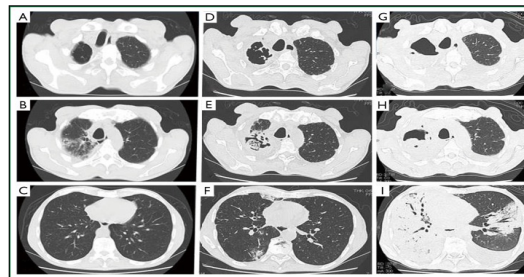


Scanning electron micrographs of crystals of (a) cobalt oxalate and (b) zinc oxalate produced by the soil fungus *Aspergillus niger* during the solubilization of

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## Calcium oxalate crystal deposition in a patient with *Aspergilloma* due to *Aspergillus niger*



Thoracic CT 9 months (A, B, C) and 3 weeks (D, E, F) before arrival at our hospital and upon admission (G, H, I). Old inflammatory and cystic changes in right upper lobe (A and B); Fungal, ball-like lesion 2.5 cm in diameter with air space consolidation in right upper lobe (D and E) and mild consolidation in right lower lobe (F); Right lung (G) and left middle lobe (H) are replaced by massive consolidation with air and bilateral pleural effusion is evident (I).

Source: *J Thorac Dis.* 2013 Aug; 5(4): E174–E178

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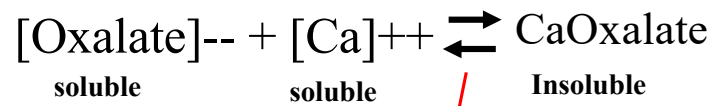
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# The Chemistry of Oxalate

## *Solubility Factors*

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### Solubility Problem With Oxalate



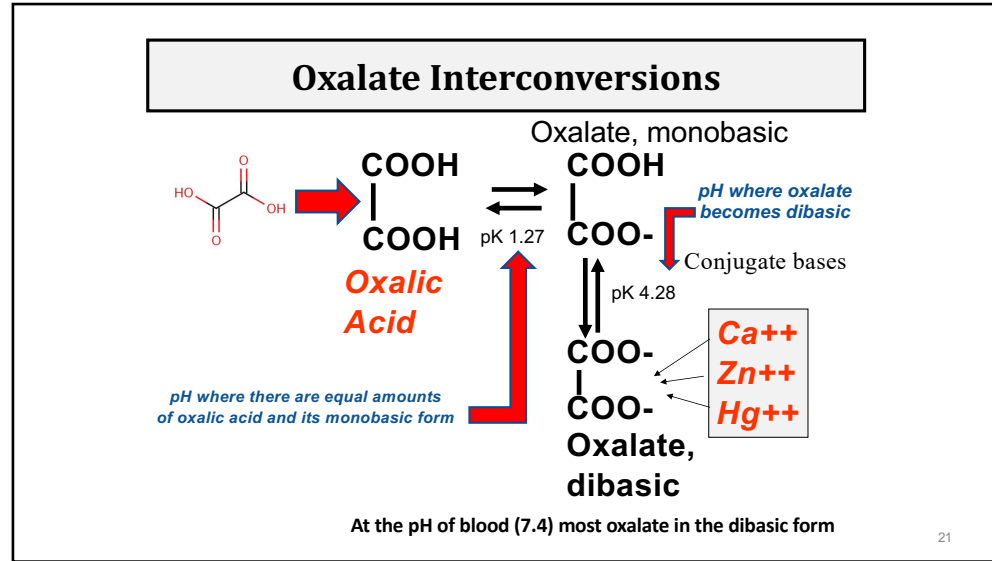
*The higher the solubility product constant is, the more soluble the compound*

K<sub>sp</sub> is indicator of  
Strength of reaction

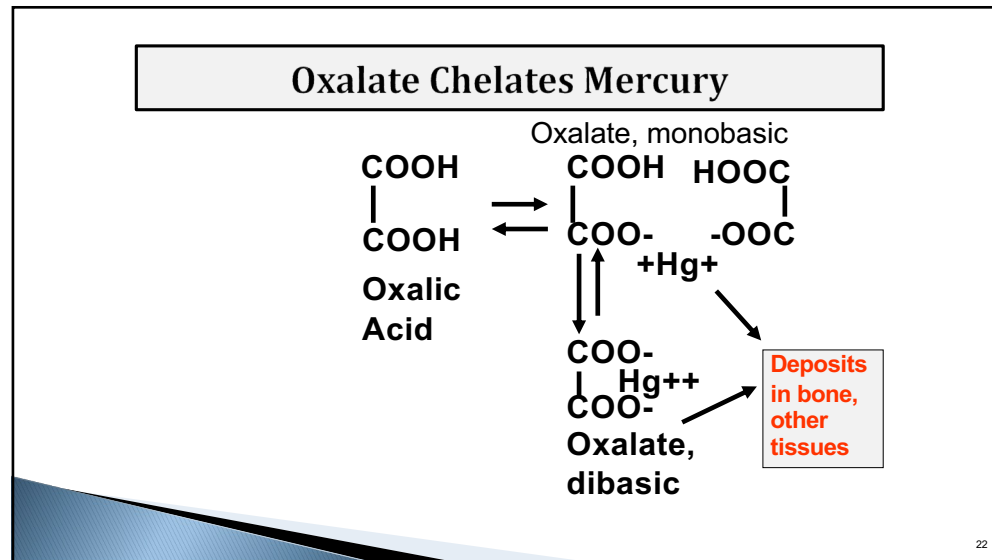
*Its value indicates the degree to which a compound dissociates in water*

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22

### Solubility is the Factor That Determines Oxalate and Heavy Metal Toxicity

Salt K<sub>sp</sub> (solubility product constant)

Mercury I	1.75 X 10 <sup>-13</sup>
Lead	8.6 X 10 <sup>-10</sup>
Copper II	4.4 X 10 <sup>-10</sup>
Zinc	1.4 X 10 <sup>-9</sup>
Cadmium	1.42 X 10 <sup>-8</sup>
Calcium	1.5 X 10 <sup>-8</sup>
Magnesium	8.5 X 10 <sup>-5</sup>

The larger the number in the negative exponent, the smaller the numerical value

*The smaller the value of the K<sub>sp</sub>, the greater insolubility of the salt. For example, the lower the K<sub>sp</sub> value for Mercury versus Calcium means it is more insoluble - less likely to dissociate.*

The Mercury-Oxalate Salt is approximately 100,000K less soluble than Calcium-Oxalate.

23

23

### Some Facts About Oxalate Chemistry

- ▶ At the pH of blood most oxalate is in the dibasic form
- ▶ Oxalates can form salts with a wide variety of metals
- ▶ Calcium levels in blood are relatively constant, but oxalates levels can vary widely.
- ▶ **It is the oxalate level in the blood which tends to drive calcium (or other mineral/metal) oxalate crystal formation in tissues.**

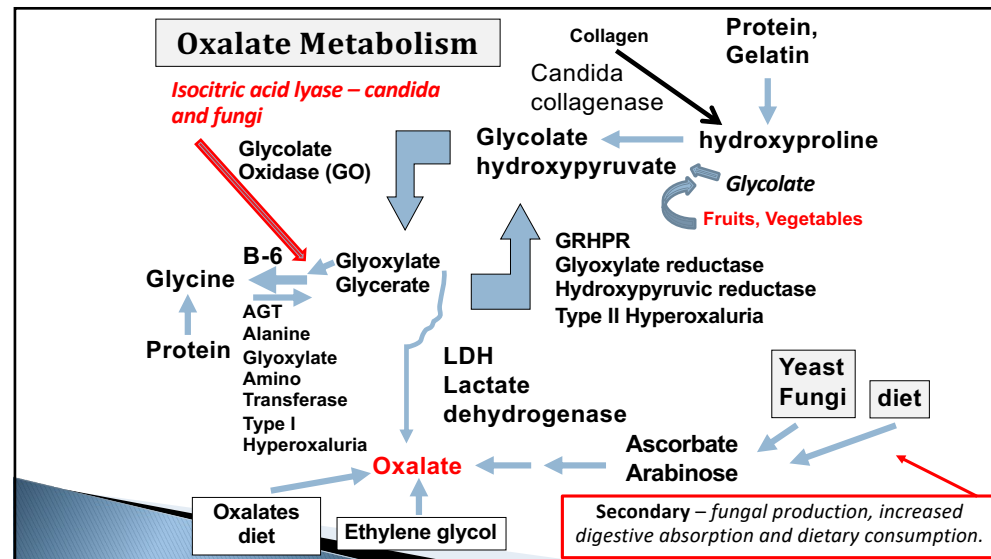
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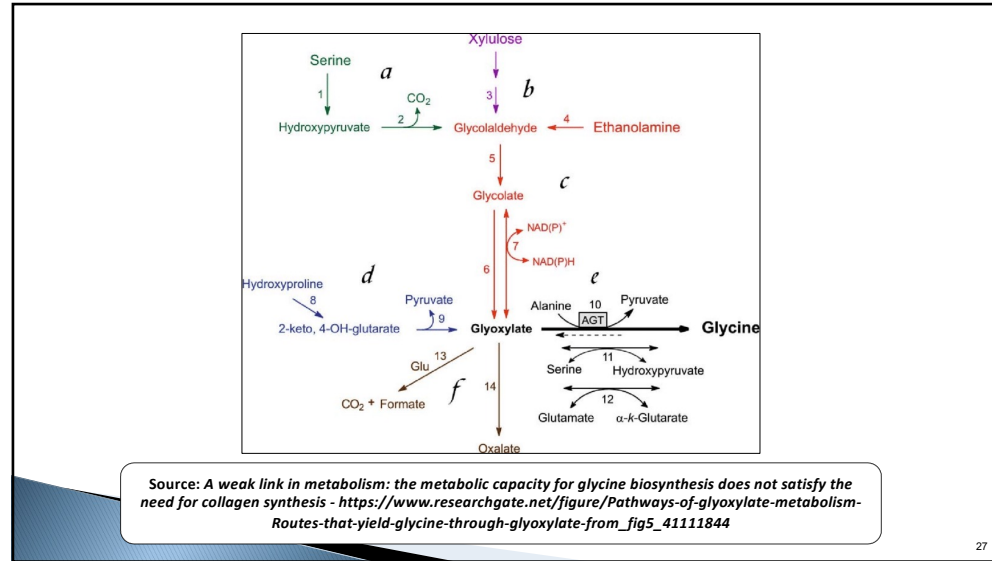
## Magnesium & Vitamin B6 Deficiency

1. Invest Urol. 1966 Sep;4(2):133-42. *Calcium oxalate lithiasis produced by pyridoxine deficiency and inhibition with high magnesium diets.* Lyon ES, et. al.
2. J Urol. 1982 Mar;127(3):598-604. *Effects of magnesium deficiency on intratubular calcium oxalate formation and crystalluria in hyperoxaluric rats.* Rushton HG, Spector M.

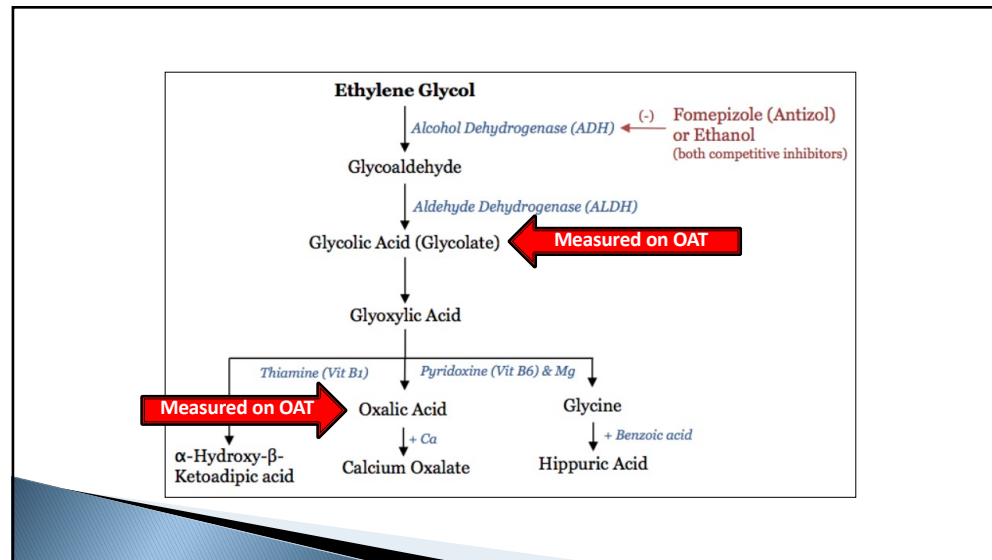
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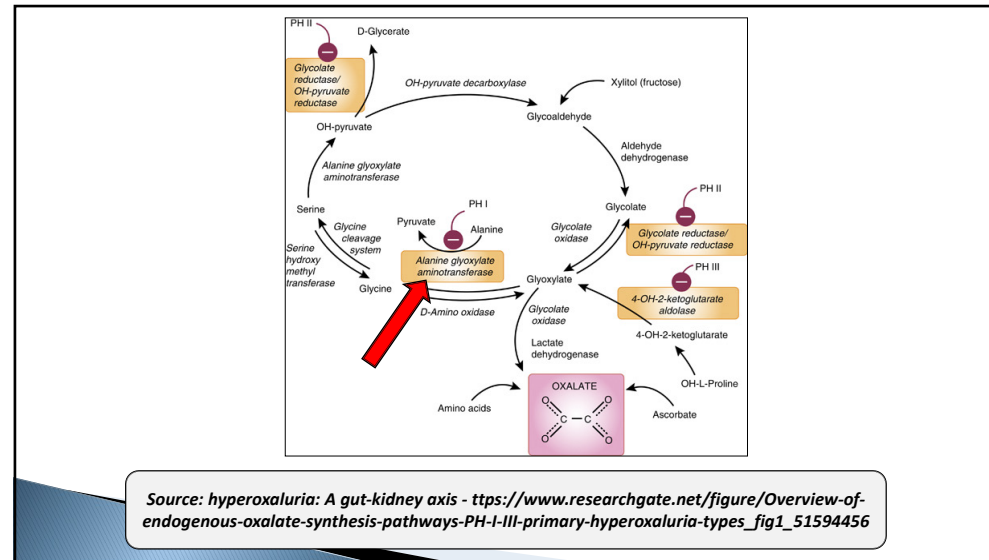
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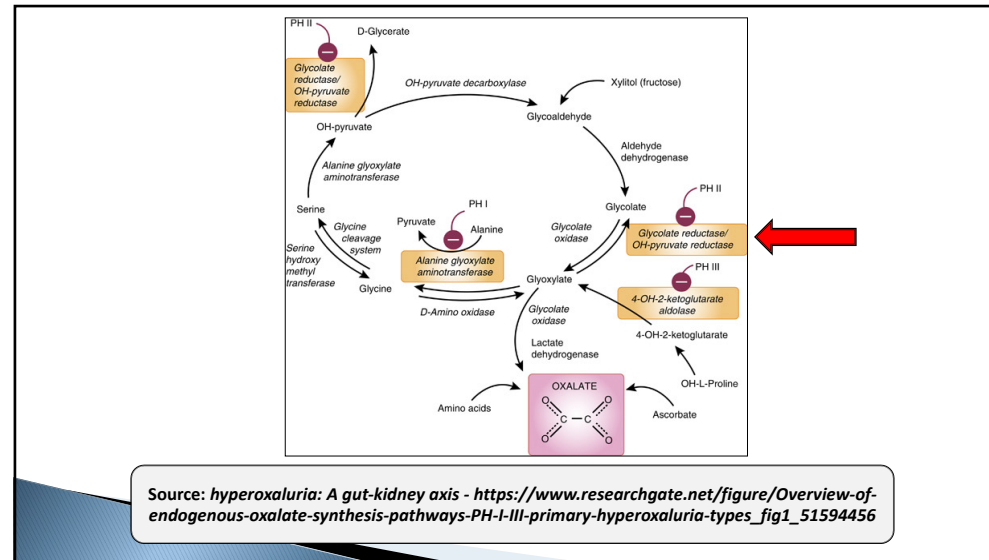
29

## Hyperoxaluria Types

- ▶ **Type I (PH1)** - Primary Hyperoxaluria Type 1 is caused by the deficiency of the oxalate breakdown liver specific enzyme called alanine:glyoxylate aminotransferase:
  - AGT is a Vitamin B6 dependent enzyme
  - Leads to high glyoxylic acid which is then converted to glycolate by the enzyme GRHPR or to oxalate by LDH (*lactate dehydrogenase*).
  - **Elevated Oxalate and Glycolate (glycolic on the OAT)**

20 Glycolic 16 - 117 H 119 119

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31

## Hyperoxaluria Types

- ▶ **Type 2 (PH2)** – Primary Hyperoxaluria Type 2 is caused by the deficiency of Glyoxylate reductase/hydroxypyruvate reductase (GRHFR):
  - It is often less severe than Type 1 usually causing kidney stone damage versus end-stage kidney failure.
  - Tend to see elevated Oxalate and Glycerate (glyceric on OAT).

19 Glyceric 0.74 - 13 H 104

104

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## Vulvodynia

- ▶ It is a syndrome of unexplained vulvar pain, frequently accompanied by physical disabilities, limitation of daily activities, sexual dysfunction and psychological distress.
- ▶ The patient's vulvar pain usually has an acute onset and, in most cases, becomes a chronic problem lasting months to years.
- ▶ **The pain is often described as burning or stinging, or a feeling of rawness and irritation.**

33

33

Vulvodynia. Julius F. Metts, M.D. Ref: Vulvodynia and Vulvar Vestibulitis: Challenges in Diagnosis and Management. March 15, 1999 - American Academy of Family Physicians

- ▶ **Cyclic vulvovaginitis is believed to be a reaction to yeast**, which may be detected at times, and not detected at other times with KOH preparation or fungal cultures.
- ▶ **Because of the link with *Candida*, treatment for cyclic vulvovaginitis may include anti-candidal medication even if cultures are not positive.**
- ▶ Other treatments for vulvodynia are a low-oxalate diet and the addition of oral calcium citrate (CitraCal), two tablets (200 mg/950 mg each), two to three times a day.

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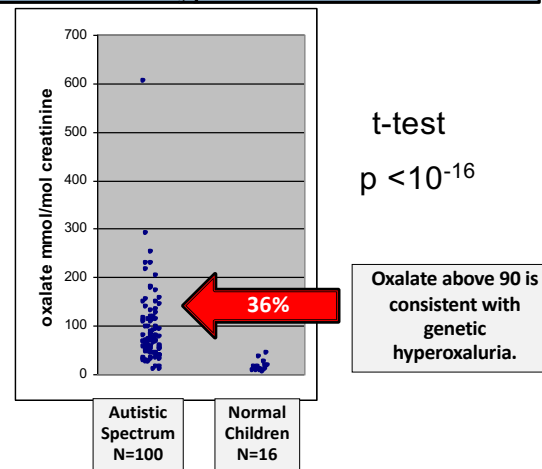
### Common Patient Complaints/Observations

- ▶ Sandy and grainy stools
- ▶ Bladder irritability, urethral pain, vulvar pain
- ▶ Pain on urination (but, no confirmation of infection)
- ▶ Eye pain (eye poking in some children)
- ▶ Body aches, burning feeling in muscles
- ▶ Fibromyalgia-like discomfort
- ▶ Moodiness, irritability, and aggressive behavior commonly seen in autism.
- ▶ Tendon pain, trigger point tenderness, increased tension in muscles with movement.

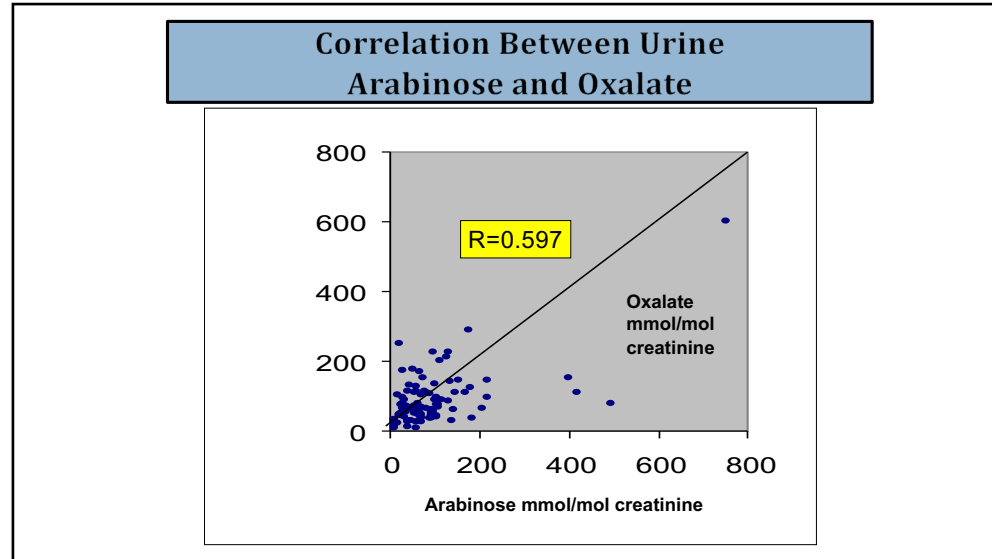
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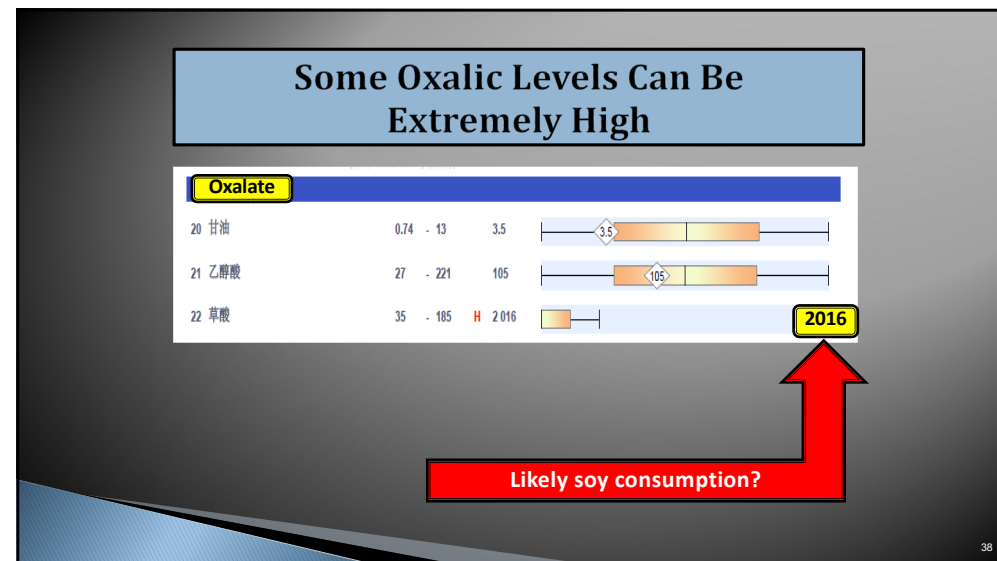
### Comparison of Urine Oxalate in Autistic-Spectrum and Neurotypical Children



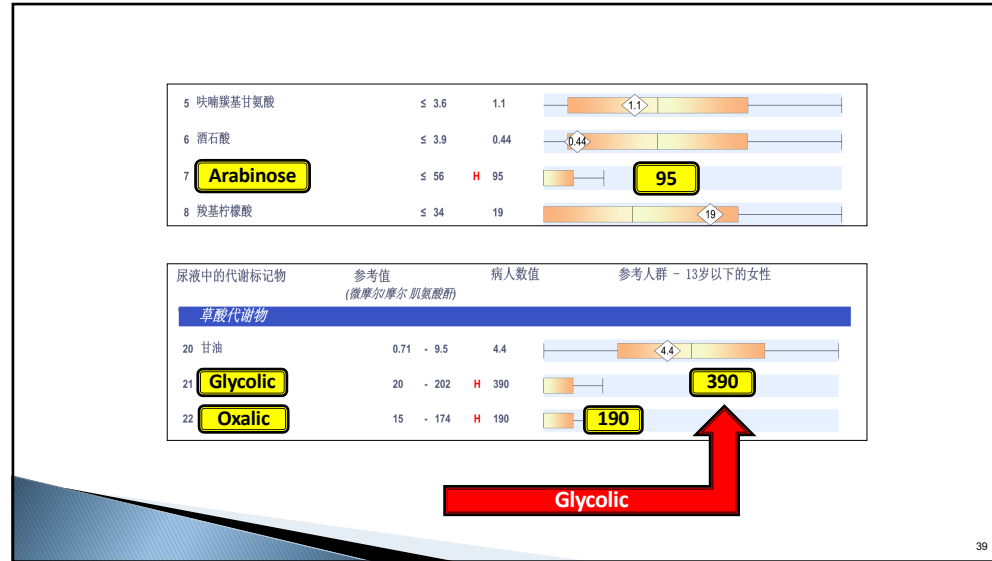
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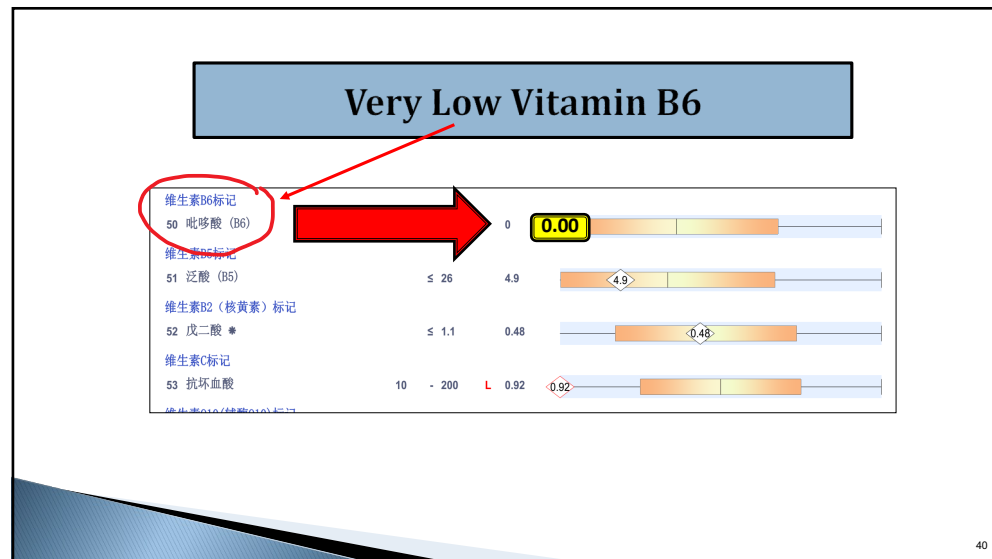
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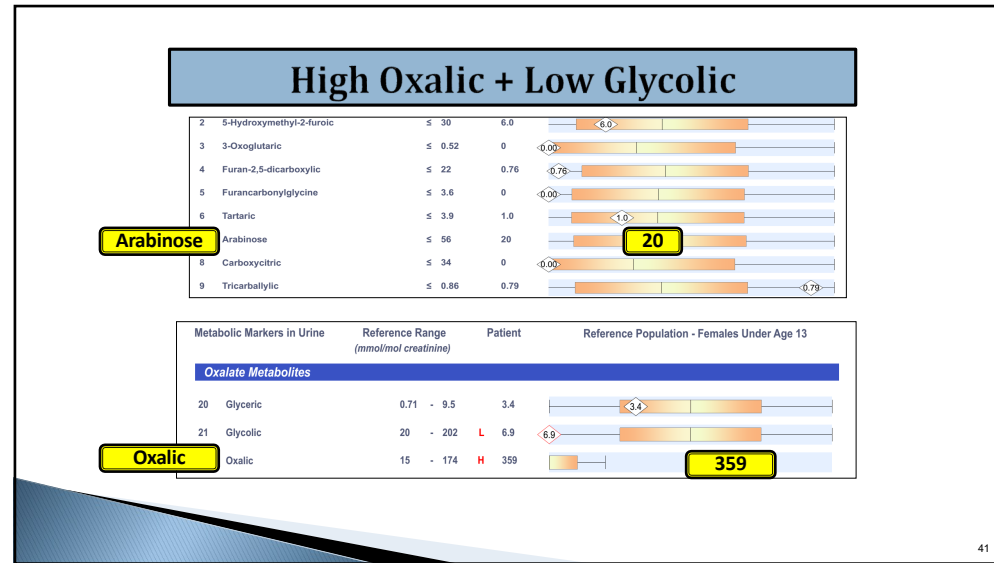
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41

## Resource Article



The Great Plains Laboratory, Inc.

### Oxalate Control

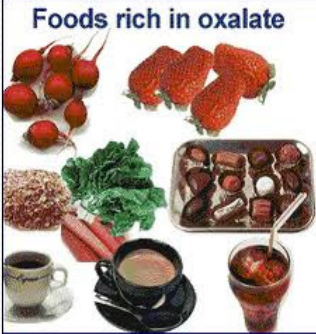
**Overview**  
 The Organic Acids Test by The Great Plains Laboratory, Inc. is the only OAT on the market that evaluates levels of oxalates in urine. Oxalate (and its acid form, oxalic acid), is an organic acid that is primarily derived from three sources: the diet, fungus (such as Aspergillus and Penicillium), 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, hyperoxaluria 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.

42

## Food Examples High in Oxalate

### Foods rich in oxalate




### Good Place To Start

- ▶ **Spinach**
- ▶ **Soy Products**
- ▶ Nuts (including nut milk and butters).
- ▶ Berries (including berry juice and jams).

43

43

## Green Smoothie or Juice



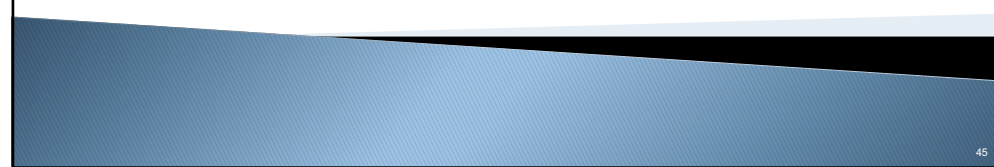


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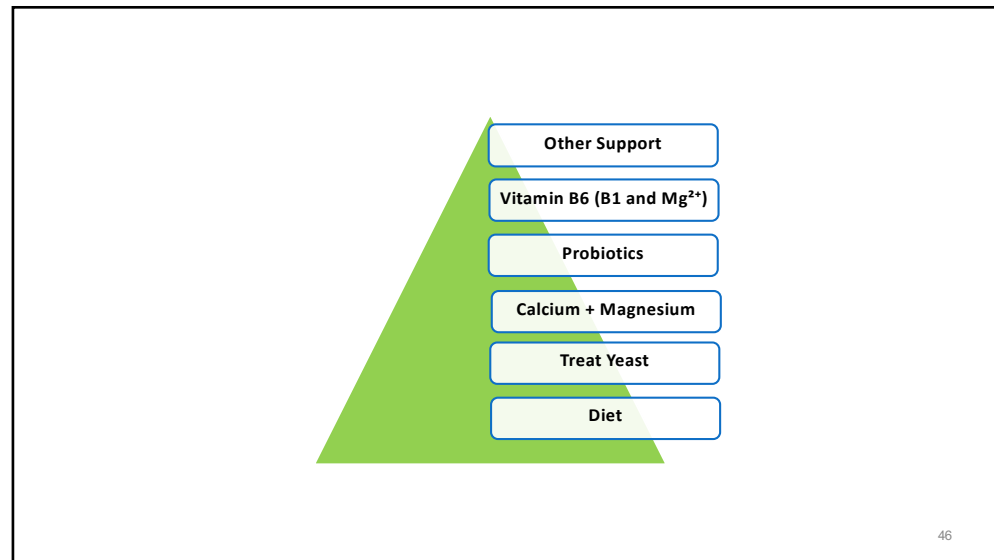
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# Treating High Oxalate

## *Beyond Dietary Intervention*



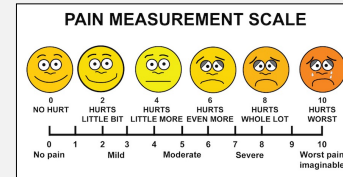
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46

## Oxalate Dumping

- Sandy or grainy stools
- Pain with urination
- Urinary urgency
- Irritability, moodiness, etc.
- 'Potty' accidents
- Painful bowel movements
- Possible rash - red bumps on skin, hives, may be itchy
- Yeast flare



47

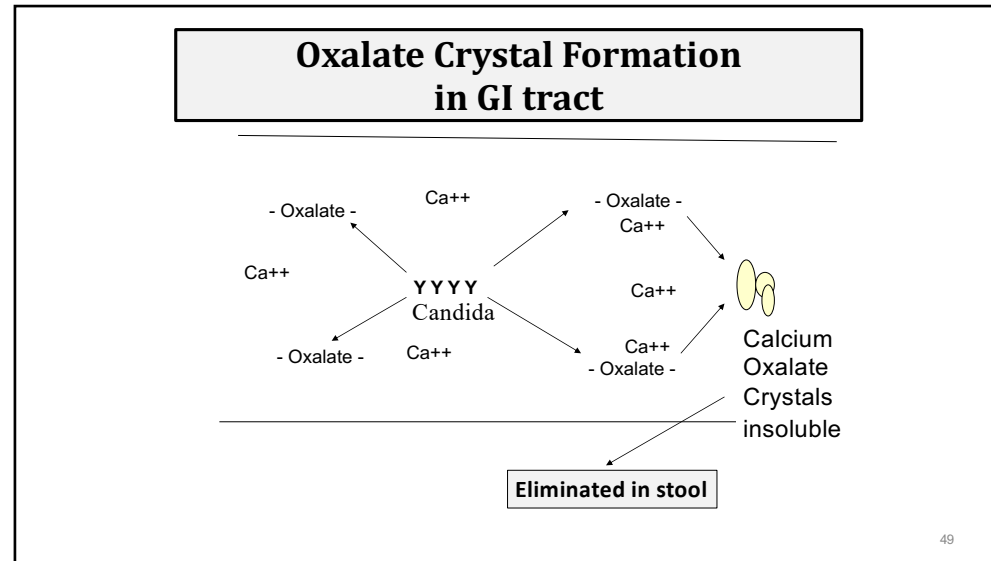
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## Supplement Support For High Oxalate

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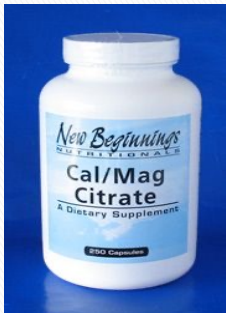
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49

### Calcium/Magnesium Citrate (capsules)



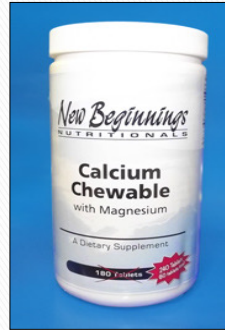
- ▶ 1 to 2 capsules before high oxalate meals to help prevent oxalate absorption.
- ▶ Capsules can be swallowed or opened-up and mixed into food or drink.

2 capsules = 147 mg of calcium & 96 mg of magnesium

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## Calcium Chewable w/Magnesium



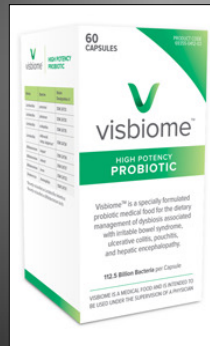
- ▶ 1 tablet with meals containing low to medium oxalates.
- ▶ 2 tablets with meals containing high oxalates.

**1 tablet = 247 mg of calcium & 50 mg of magnesium**

51

51

## Visbiome = High Dose Probiotic



**2 capsules = 225 billion organisms**

Supplement Facts		
Serving size	1 Capsules	%DV
Servings per container	60	
live, freeze-dried, lactic acid bacteria	112.5 billion CFU	*
* Daily Value not established.		
Other Ingredients: Lactic acid bacteria, microcrystalline cellulose, (stearate, silicon dioxide, stearic acid, magnesium stearate, silicon dioxide and vegetable capsule). Contains milk from highly concentrated natural yogurt bacteria which are grown using dairy ingredients to ensure their health and vitality. Trace levels of dairy are present in the finished product. (0.01 g lactose per 200 capsules)		
<b>Strains of Bacteria Include:</b>		
Lactobacillus paracasei (DSM 24733)		
Lactobacillus plantarum (DSM 24730)		
Lactobacillus acidophilus (DSM 24735)		
Lactobacillus delbrueckii subspecies bulgaricus** (DSM 24734)		
Bifidobacterium longum* (DSM 24736)		
Bifidobacterium infantis* (DSM 24737)		
Bifidobacterium breve (DSM 24732)		
Streptococcus thermophilus (DSM 24731)		
*Recently reclassified as B. lactis		
**Reclassified as L. helveticus		

52

52

## Vitamin B6

- ▶ Pyridoxine HCL
- ▶ Helps in oxalate metabolism enzyme function.
- ▶ 50mg to 100mg+ daily

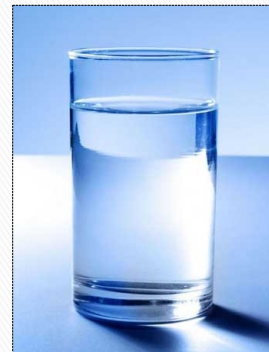


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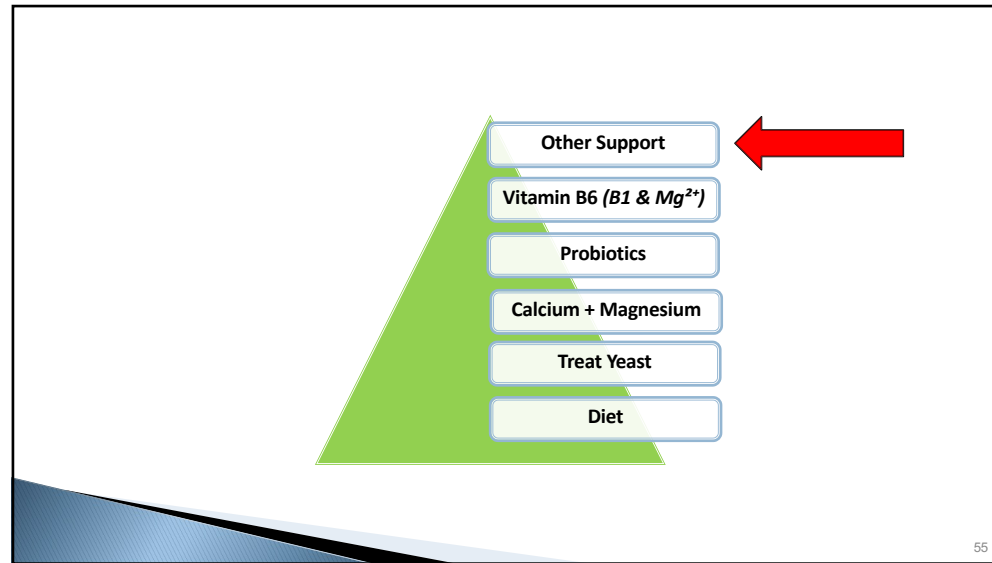
## Hydrate

- ▶ Consume  $\frac{1}{2}$  body weight in ounces of liquid daily.
- ▶ For example, a 150 lbs. (68kg) *person* should drink approximately 75 ounces (2.2 liters) of fluids daily.
- ▶ 1 fluid ounce = 0.0295 liters
- ▶ Adjust consumption with increased activity.



54

54



55

### How Can High Oxalates Be Treated?

- Implement a low-oxalate diet. This may be especially important if the condition has been present for a long time and there is high tissue oxalate buildup.
- Use antifungal drugs to reduce yeast and fungi that may contribute to oxalate production. Some treatments may require years of antifungal treatment. Arabinose, a metabolite of yeast, is a marker for yeast. The Organic Acids Test is correlated with high amounts of oxalate.
- 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.

The Great Plains Laboratory, Inc.


**Oxalate Control**

56

## Things to Do (and Not Do) with High Oxalate Patients

By Julie Matthews  
Certified Nutrition Consultant

<https://NourishingHope.com>



57

### Remove Oxalate VERY SLOWLY From The Diet

- ▶ 5-10% per week
- ▶ For high oxalate patients, this could take a couple months or more.
- ▶ Removing them quickly can cause “dumping” symptoms, pain and can overwhelm the system.

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58

58

## Cooking to Reduce High Oxalate

- Reduction from boiling and soaking – *reduces soluble oxalate by approx. 50%. Discard the water eating.*
- Roasting at high heat for 30 minutes can reduce oxalates in tubers.
- Not enough to make extremely high oxalate foods low enough to consume for a low oxalate diet:
  - *Extremely high oxalates foods: Beets, sweet potato, spinach, Swiss Chard and amaranth reduced by 50% will still be very high.*
  - *Although, cooking can help get medium/high vegetables (12-20 mg) into an acceptable range.*

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59

59

## High Oxalate *A Case of Chronic Pain*

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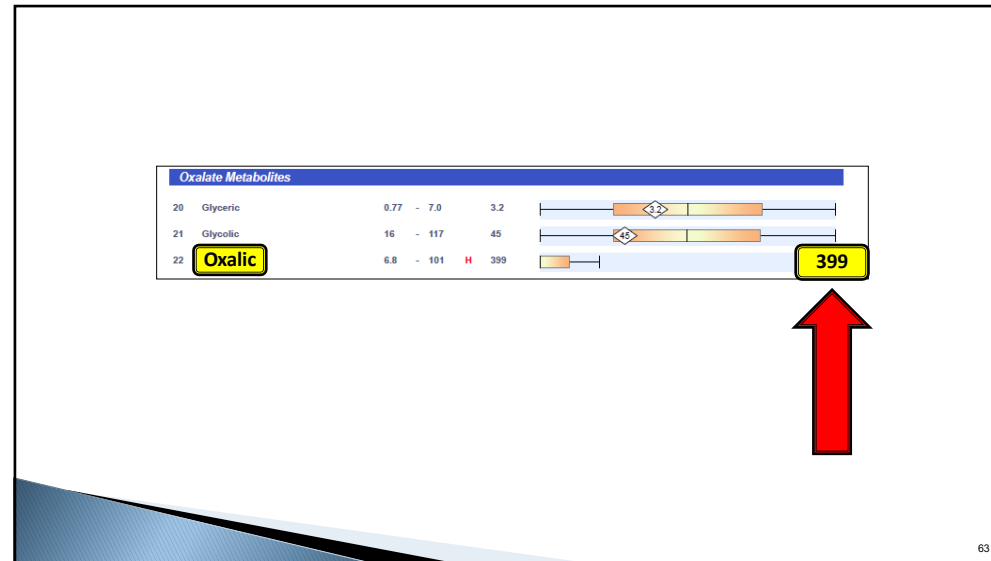
- ▶ 43-year-old female
- ▶ **Chief complaints:** pressure headaches, fatigue, brain fog, body aches, and tendon pain. Cyclical urinary pain (sharp). Digestive discomfort (bloating, painful bowel movements).
- ▶ **PmHx:** *Blastocystis* and *Cryptosporidium*, Raynaud's, Irritable Bowel Syndrome (IBS).
- ▶ **Meds:** Ibuprofen, Atarax (for suspected interstitial cystitis).
- ▶ **Food reactions** – notices severe muscle pain when eats nuts and vegetables.

61

### Mildly High Arabinose, But Normal Clostridia Markers

Arabinose	Arabinose	≤ 29	H	51	51
8	Carboxycitric	≤ 29		1.5	<1.5
9	Tricarballic	≤ 0.44		0.06	<0.06
<b>Malabsorption and Bacterial Markers</b>					
10	2-Hydroxyphenylacetic	0.06 - 0.66		0.26	<0.26
11	4-Hydroxyphenylacetic	≤ 19		9.3	<9.3
12	4-Hydroxybenzoic	≤ 1.3		0.45	<0.45
13	4-Hydroxyhippuric	0.79 - 17		4.8	<4.8
14	Hippuric	≤ 613		275	<275
15	3-Indoleacetic	≤ 11		1.5	<1.5
16	Succinic	≤ 9.3		3.5	<3.5
17	HPHPA <small>(other pathogenic clostridia species)</small>	≤ 208		47	<47
18	4-Cresol ( <i>C. difficile</i> )	≤ 75		25	<25
19	DHPPA (Beneficial Bacteria)	≤ 0.38		0.20	<0.20

62



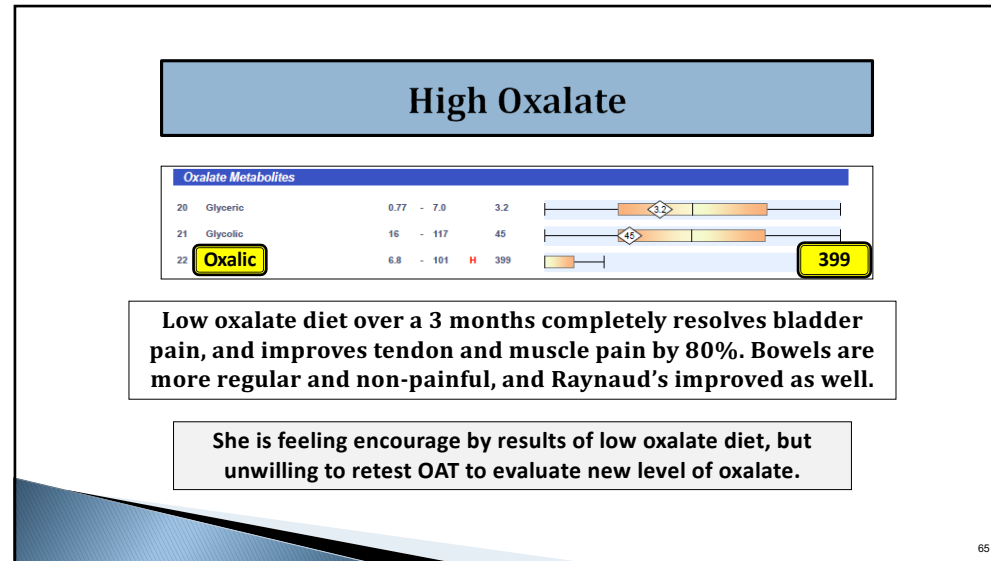
63

### Low Oxalate Program (example)

- ▶ Low oxalate diet:
  - *Prioritized to avoid spinach (and other high oxalate veggies), soy products, nuts and berries.*
- ▶ Cal/Mag Citrate:
  - *Approximately, 250mg of Calcium + 50mg of Magnesium per meal (example dose).*
- ▶ High potency probiotic:
  - *Visbiome – two capsules daily at approx. 225 billion organisms per capsule (example dose).*
- ▶ Vitamin B6 – one tablet daily, e.g., 50mg (example dose)
- ▶ Epsom Salt Baths – four+ times weeks (2 cups of Epsom Salt in bath water, if tolerated).

64





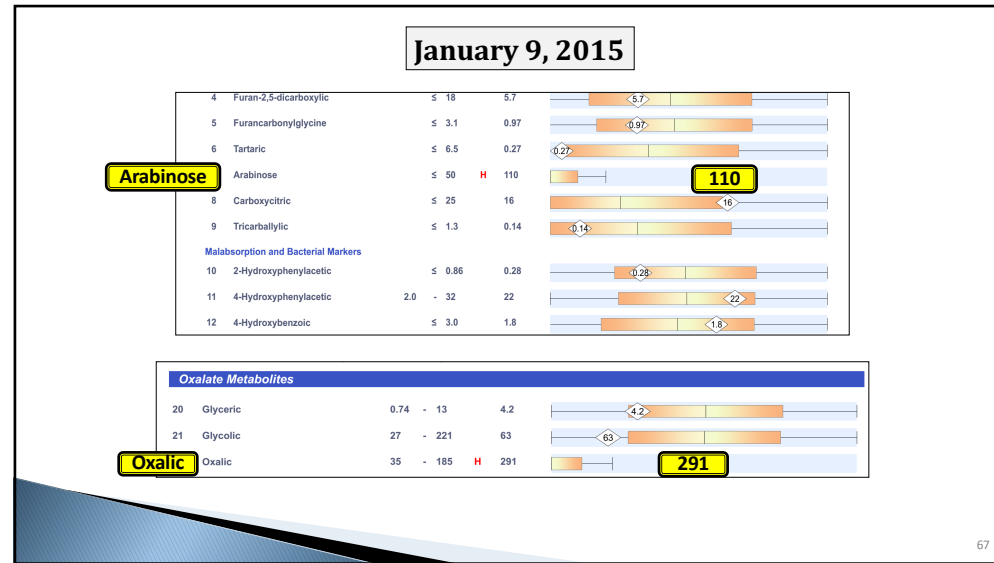
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## Normalization of High Oxalate and Chronic Candida

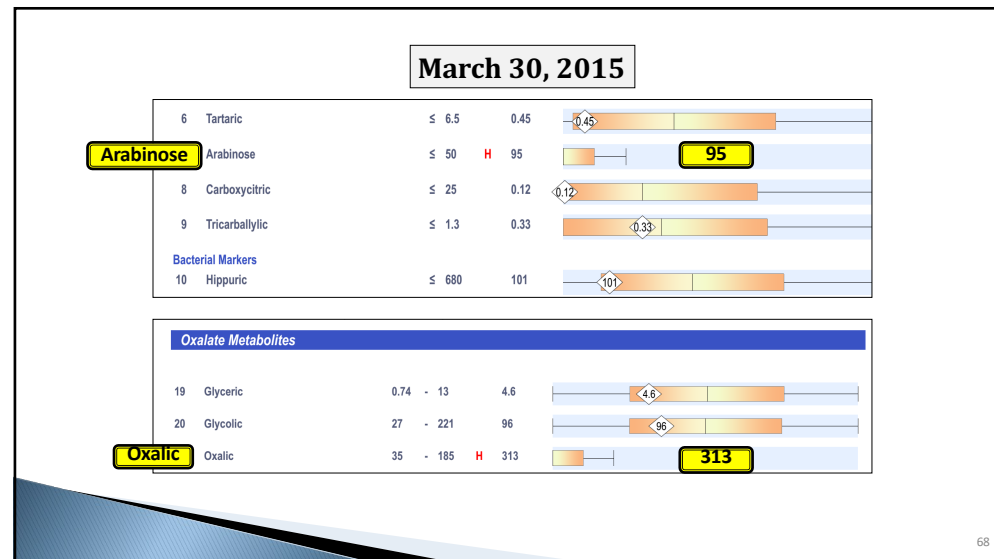
*Consistent and ongoing botanical antimicrobials, anti-candida and low oxalate diets*

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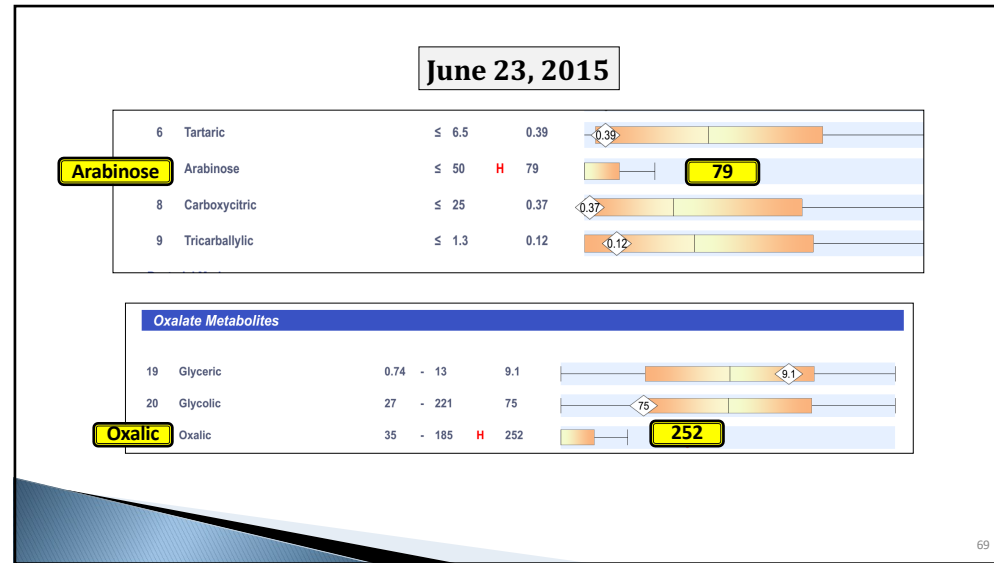
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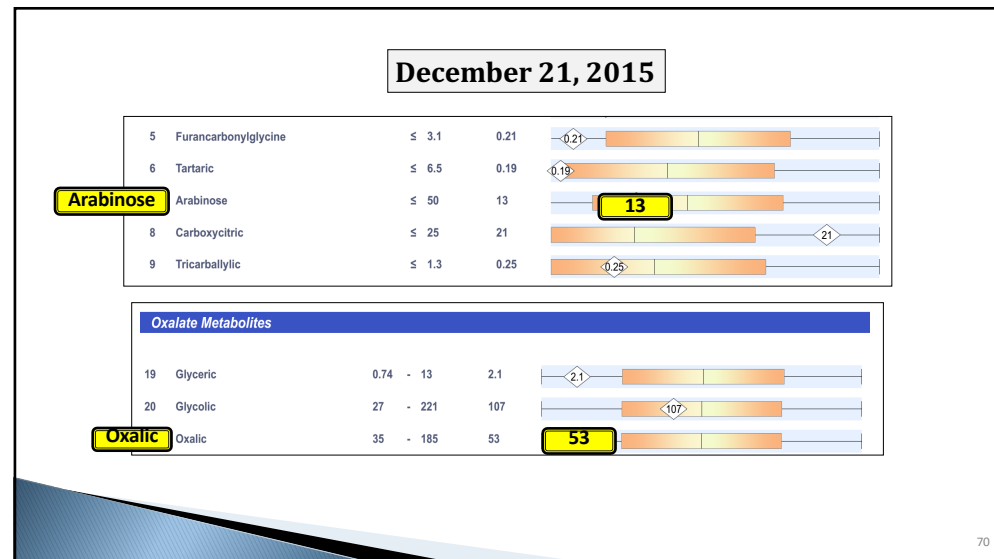
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68



69



70

## Dr. Woeller OAT Lecture Support Document



### Low Oxalate Program (example) By Kurt N. Woeller, D.O.

#### Low Oxalate Diet:

Commonly consumed foods high in oxalates are Spinach, Berries (including juice), Nuts (including nut butters) and Soy. There are many other high oxalate foods as well that individual patients/clients may be consuming. There are various online resources available for more information regarding high oxalate foods and the incorporation of a low oxalate diet:

- *Low Oxalate.info* – <https://lowoxalate.info>
- *Great Plains Laboratory Oxalate Control brochure* – <https://greatplainslaboratory.com>. Their brochure regarding low oxalate information is found in the 'Organic Acids Test (OAT)' section.
- *The Vulvar Pain (VP) Foundation* – <https://thepfoundation.org>
- *Nourishing Hope (Julie Matthews, CNC.)* – <https://nourishinghope.com>

Reducing the consumption of high oxalate foods is essential for a low oxalate program. Have patient/client access one or more of the above listed websites for a more thorough analysis of their consumption of high oxalate foods. Also, incorporating certain supplements can help with the elimination of oxalates.

71

71

**BEYOND THE BASICS:**  
ADVANCED ORGANIC ACIDS TESTING STRATEGIES

THANK YOU  
Next Lecture

Quinolinic Acid and Its Link to Normal Cellular Energy Metabolism and Neurotoxicity

72