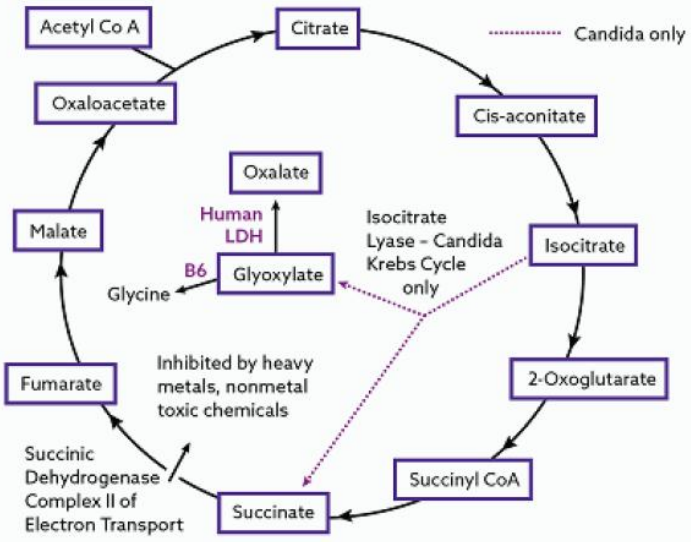
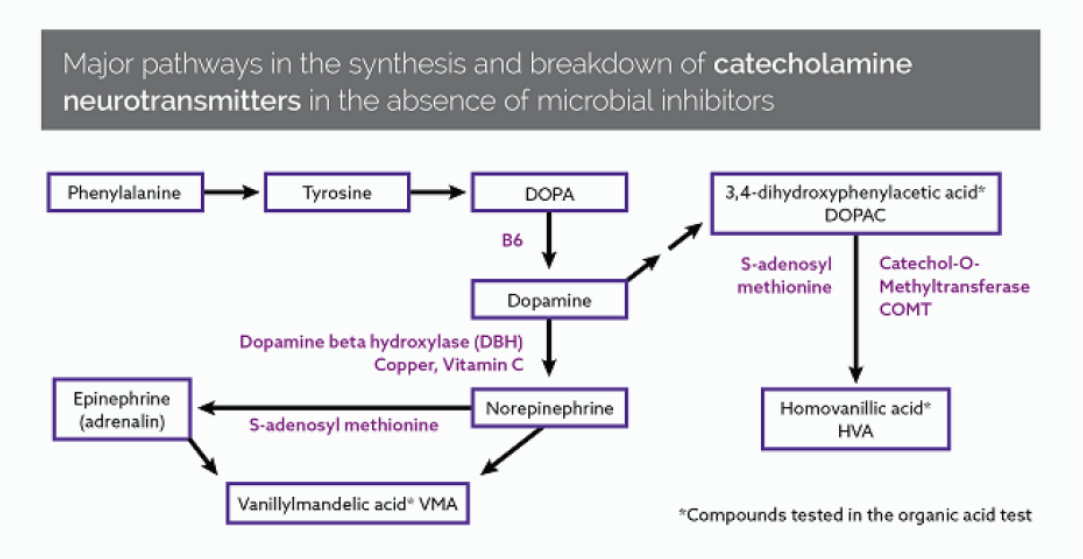
Intestinal Microbial Overgrowth

Yeast and Fungal Markers					
1	Citramalic	≤ 5.3		1.5	
2	5-Hydroxymethyl-2-furoic *(Aspergillus)*	≤ 30		2.1	
3	3-Oxoglutaric	≤ 0.52		0.04	
4	Furan-2,5-dicarboxylic *(Aspergillus)*	≤ 22		2.5	
5	Furancarbonylglycine *(Aspergillus)*	≤ 3.6		0	
6	Tartaric *(Aspergillus)*	≤ 3.9		0.53	
7	Arabinose	≤ 56	H	78	
8	Carboxycitric	≤ 34		0	
9	Tricarballylic *(Fusarium)*	≤ 0.86		0.28	
Bacterial Markers					
10	Hippuric	≤ 717		57	
11	2-Hydroxyphenylacetic	≤ 1.1		0.23	
12	4-Hydroxybenzoic	0.09 - 2.0		0.55	
13	4-Hydroxyhippuric	≤ 27		12	
14	DHPPA (Beneficial Bacteria)	≤ 0.73		0.04	
Clostridia Bacterial Markers					
15	4-Hydroxyphenylacetic *(C. difficile, C. stricklandii, C. lituseburense & others)*	≤ 30		12	
16	HPHPA *(C. sporogenes, C. caloritolerans, C. botulinum & others)*	≤ 227		54	
17	4-Cresol *(C. difficile)*	≤ 76		32	
18	3-Indoleacetic *(C. stricklandii, C. lituseburense, C. subterminale & others)*	≤ 11		0.67	

Human Krebs Cycle showing Candida Krebs Cycle variant that causes excess Oxalate via Glyoxylate





Metabolic Markers in Urine	Reference Range (mmol/mol creatinine)	Patient Value	Reference Population - Females Under Age 13
Oxalate Metabolites			
19 Glyceric	0.71 - 9.5	2.1	2.1
20 Glycolic	20 - 202	198	198
21 Oxalic	15 - 174	76	76
Glycolytic Cycle Metabolites			
22 Lactic	0.18 - 44	18	18
23 Pyruvic	0.88 - 9.1	5.2	5.2
Mitochondrial Markers - Krebs Cycle Metabolites			
24 Succinic	≤ 15	8.2	8.2
25 Fumaric	0.04 - 1.3	0.28	0.28
26 Malic	≤ 2.2	0.49	0.49
27 2-Oxoglutaric	≤ 81	18	18
28 Aconitic	11 - 35	L 8.7	8.7
29 Citric	59 - 440	153	153
Mitochondrial Markers - Amino Acid Metabolites			
30 3-Methylglutaric	0.07 - 0.95	0.21	0.21
31 3-Hydroxyglutaric	≤ 11	4.9	4.9
32 3-Methylglutaconic	≤ 6.4	0.71	0.71

Neurotransmitter Metabolites

Phenylalanine and Tyrosine Metabolites

		Reference Range	Patient Value
33	Homovanillic (HVA) *(dopamine)*	≤ 14	2.1
34	Vanillylmandelic (VMA) *(norepinephrine, epinephrine)*	0.87 - 5.9	1.1
35	HVA / VMA Ratio	0.12 - 3.0	2.0
36	Dihydroxyphenylacetic (DOPAC) *(dopamine)*	0.07 - 4.0	1.1
37	HVA/ DOPAC Ratio	1.5 - 2.6	1.9

Tryptophan Metabolites

		Reference Range	Patient Value
38	5-Hydroxyindoleacetic (5-HIAA) *(serotonin)*	≤ 7.7	1.2
39	Quinolinic	0.63 - 6.7	2.3
40	Kynurenic	≤ 4.1	1.4

Metabolic Markers in Urine	Reference Range *(mmol/mol creatinine)*	Patient Value	Reference Population - Females Under Age 13

Pyrimidine Metabolites - Folate Metabolism

		Reference Range	Patient Value
41	Uracil	≤ 19	2.0
42	Thymine	0.01 - 0.89	0.12

Ketone and Fatty Acid Oxidation

		Reference Range	Patient Value
43	3-Hydroxybutyric	≤ 4.1	2.4
44	Acetoacetic	≤ 10	0.39
45	Ethylmalonic	≤ 4.6	1.6
46	Methylsuccinic	≤ 4.3	1.1
47	Adipic	≤ 9.7	2.1
48	Suberic	≤ 9.5	1.8
49	Sebacic	≤ 0.37	0.16

Nutritional Markers

Vitamin B12

		Reference Range	Patient Value
50	Methylmalonic ✱	≤ 6.2	2.0

Vitamin B6

		Reference Range	Patient Value
51	Pyridoxic (B6)	≤ 59	0

Vitamin B5

		Reference Range	Patient Value
52	Pantothenic (B5)	≤ 26	7.8

Vitamin B2 (Riboflavin)

		Reference Range	Patient Value
53	Glutaric ✱	≤ 1.1	0.43

Vitamin C

		Reference Range	Patient Value
54	Ascorbic	10 - 200	L 0.69

Vitamin Q10 (CoQ10)

		Reference Range	Patient Value
55	3-Hydroxy-3-methylglutaric ✱	≤ 101	14

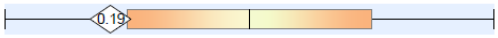
Glutathione Precursor and Chelating Agent

		Reference Range	Patient Value
56	N-Acetylcysteine (NAC)	≤ 0.41	0

Biotin (Vitamin H)

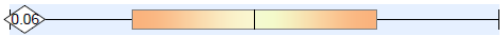
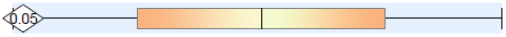
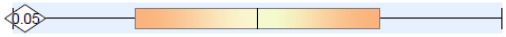
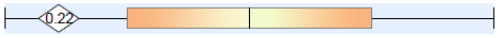
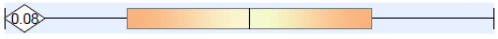
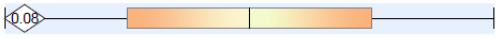
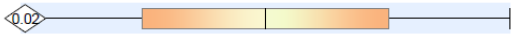
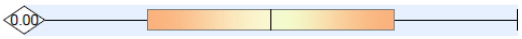
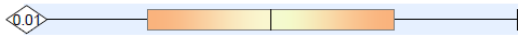
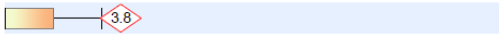
		Reference Range	Patient Value
57	Methylcitric ✱	≤ 5.5	1.0

✱ *A high value for this marker may indicate a deficiency of this vitamin.*

Metabolic Markers in Urine	Reference Range (mmol/mol creatinine)	Patient Value	Reference Population - Females Under Age 13
Indicators of Detoxification			
Glutathione			
58 Pyroglutamic *	7.0 - 63	23	
Methylation, Toxic exposure			
59 2-Hydroxybutyric **	≤ 2.2	1.4	
Ammonia Excess			
60 Orotic	≤ 0.88	0.19	
Aspartame, salicylates, or GI bacteria			
61 2-Hydroxyhippuric	≤ 1.2	0.27	

* *A high value for this marker may indicate a Glutathione deficiency.*

** *High values may indicate methylation defects and/or toxic exposures.*

Amino Acid Metabolites			
Low values are not associated with inadequate protein intake and have not been demonstrated to indicate specific amino acid deficiencies.			
62 2-Hydroxyisovaleric	≤ 2.0	0.06	
63 2-Oxoisovaleric	≤ 2.4	0.05	
64 3-Methyl-2-oxovaleric	≤ 2.0	1.3	
65 2-Hydroxyisocaproic	≤ 2.0	0.05	
66 2-Oxoisocaproic	≤ 2.0	0.22	
67 2-Oxo-4-methiolbutyric	≤ 2.0	0.08	
68 Mandelic	≤ 2.0	0.08	
69 Phenyllactic	≤ 2.3	0.02	
70 Phenylpyruvic	≤ 2.3	0	
71 Homogentisic	≤ 2.0	0.01	
72 4-Hydroxyphenyllactic	≤ 2.0	0.17	
73 N-Acetylaspartic	≤ 38	2.6	
74 Malonic	≤ 12	5.8	
75 4-Hydroxybutyric	≤ 3.4	H 3.8	
Mineral Metabolism			
76 Phosphoric	1,000 - 7,300	1,096	

Indicator of Fluid Intake

77	*Creatinine	243	mg/dL

*The creatinine test is performed to adjust metabolic marker results for differences in fluid intake. Urinary creatinine has limited diagnostic value due to variability as a result of recent fluid intake. Samples are rejected if creatinine is below 20 mg/dL unless the client requests results knowing of our rejection criteria.

Explanation of Report Format

The reference ranges for organic acids were established using samples collected from typical individuals of all ages with no known physiological or psychological disorders. The ranges were determined by calculating the mean and standard deviation (SD) and are defined as ± 2SD of the mean. Reference ranges are age and gender specific, consisting of Male Adult (≥13 years), Female Adult (≥13 years), Male Child (<13 years), and Female Child (<13 years).

There are two types of graphical representations of patient values found in the new report format of both the standard Organic Acids Test and the Microbial Organic Acids Test.

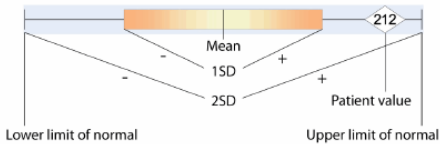
The first graph will occur when the value of the patient is within the reference (normal) range, defined as the mean plus or minus two standard deviations.

The second graph will occur when the value of the patient exceeds the upper limit of normal. In such cases, the graphical reference range is "shrunk" so that the degree of abnormality can be appreciated at a glance. In this case, the lower limits of normal are not shown, only the upper limit of normal is shown.

In both cases, the value of the patient is given to the left of the graph and is repeated on the graph inside a diamond. If the value is within the normal range, the diamond will be outlined in black. If the value is high or low, the diamond will be outlined in red.

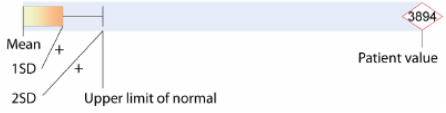
Example of Value Within Reference Range

Metabolic Markers in Urine	Reference Range (mmol/mol creatinine)		Patient Result	Reference Range - Males Age 13 and Under
Intestinal Microbial Overgrowth				
HPHPA (Clostridia marker)	<	219 .9	212	

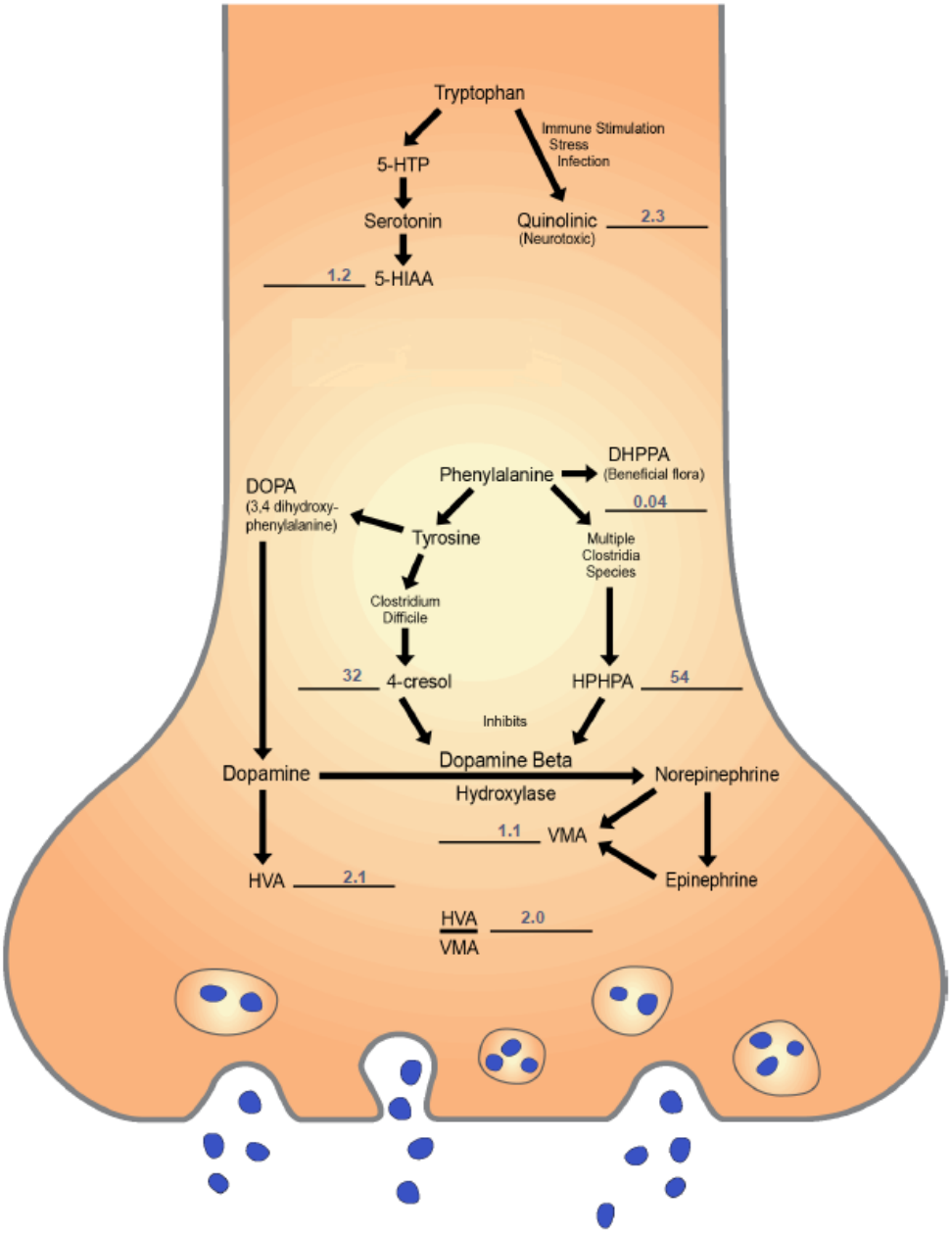


Example of Elevated Value

Metabolic Markers in Urine	Reference Range (mmol/mol creatinine)		Patient Result	Reference Range - Males Age 13 and Under
Intestinal Microbial Overgrowth				
HPHPA (Clostridia marker)	<	219 .9	H 3894	



Neurotransmitter Metabolism Markers



The diagram contains the patient's test results for neurotransmitter metabolites and shows their relationship with key biochemical pathways within the axon terminal of nerve cells. The effect of microbial byproducts on the blockage of the conversion of dopamine to norepinephrine is also indicated.

Interpretation

High yeast/fungal metabolites (1-8) Elevations of one or more metabolites indicate a yeast/fungal overgrowth of the gastrointestinal (GI) tract. Prescription or natural (botanical) anti-fungals, along with supplementation of high potency multi-strain probiotics, may reduce yeast/fungal levels.

Low or low normal citric acid (29) may be due to impaired function of the Krebs cycle, low dietary intake of citrate-containing foods such as citrus fruits and juices, potassium deficiency, acidosis (especially renal tubular acidosis), chronic kidney failure, diabetes, hypoparathyroidism, or excessive muscle activity. Low values may indicate increased risk of oxalate kidney stone formation, especially if oxalic acid is elevated also. Supplement with calcium or magnesium citrate if oxalic acid is elevated.

Homovanillic acid (HVA) levels (33) below the mean indicate low production and/or decreased metabolism of the neurotransmitter dopamine. Homovanillic acid is a metabolite of the neurotransmitter dopamine. Low production of HVA can be due to decreased intake or absorption of dopamine's precursor amino acids such as phenylalanine and/or tyrosine, decreased quantities of cofactors needed for biosynthesis of dopamine such as tetrahydrobiopterin and vitamin B6 coenzyme or decreased amounts of cofactors such as S-adenosylmethionine (Sam-e) needed to convert dopamine to HVA. In addition, a number of genetic variations such as single nucleotide polymorphisms (SNPs) or mutations can cause reduced production of HVA due to enzymes with decreased function. HVA values below the mean but which are much higher than VMA values are usually due to impairment of dopamine beta hydroxylase due to excessive Clostridia metabolites, the mold metabolite fusaric acid, pharmaceuticals such as disulfiram, or food additives like aspartame or deficiencies of cofactors such as vitamin C or copper. Values may also be decreased in patients on monoamine oxidase (MAO) inhibitors. In addition, a number of genetic variations such as single nucleotide polymorphisms (SNPs) or mutations in MAO or COMT genes can cause reduced production of HVA. Such SNPs are available on **The Great Plains DNA methylation pathway test** which can be performed on a cheek swab.

Vanillylmandelic acid (VMA) levels (34) below the mean indicate low production and/or decreased metabolism of the neurotransmitters norepinephrine and epinephrine. Vanillylmandelic acid is a metabolite of the neurotransmitters norepinephrine and epinephrine. Low production of VMA can be due to decreased intake or absorption of norepinephrine's and epinephrine's precursor amino acids such as phenylalanine and/or tyrosine, decreased quantities of cofactors needed for biosynthesis of norepinephrine and epinephrine such as tetrahydrobiopterin and vitamin B6 coenzyme or decreased amounts of cofactors such as S-adenosylmethionine (Sam-e) needed to convert norepinephrine and epinephrine to VMA. In addition, a number of genetic variations such as single nucleotide polymorphisms (SNPs) or mutations in MAO or COMT genes can cause reduced production of VMA. Such SNPs are available on **The Great Plains DNA methylation pathway test** which can be performed on a cheek swab. VMA values below the mean but which are much lower than HVA values are usually due to impairment of dopamine beta hydroxylase due to Clostridia metabolites, the mold metabolite fusaric acid, pharmaceuticals such as disulfiram, or food additives like aspartame or deficiencies of cofactors such as vitamin C or copper. Values may be decreased in patients on monoamine oxidase (MAO) inhibitors. Another cause for a low VMA value is a genetic variation (single nucleotide polymorphism or SNP) of the DBH enzyme. Patients with low VMA due to Clostridia metabolites or genetic DBH deficiency should not be supplemented with phenylalanine, tyrosine, or L-DOPA.

5-hydroxyindoleacetic acid (5HIAA) (38) levels below the mean may indicate lower production and/or decreased metabolism of the neurotransmitter serotonin. 5-hydroxy-indoleacetic acid is a metabolite of serotonin. Low values have been correlated with symptoms of depression. Low production of 5HIAA can be due to decreased intake or absorption of serotonin's precursor amino acid tryptophan, decreased quantities of cofactors needed for biosynthesis of serotonin such as tetrahydrobiopterin and vitamin B6 coenzyme. In addition, a number of genetic variations such as single nucleotide polymorphisms (SNPs) or mutations can cause reduced production of 5HIAA. Such SNPs are available on **The Great Plains DNA methylation pathway test** which can be performed on a cheek swab. Values may be decreased in patients on monoamine oxidase (MAO) inhibitors that are drugs or foods that contain tyramine such such as Chianti wine and vermouth, fermented foods such as cheeses, fish, bean curd, sausage, bologna, pepperoni, sauerkraut, and salami.

Pyridoxic acid (B6) levels below the mean (51) may be associated with less than optimum health conditions (low intake, malabsorption, or dysbiosis). Supplementation with B6 or a multivitamin may be beneficial.

Pantothenic acid (B5) levels below the mean (52) may be associated with less than optimum health conditions. Supplementation with B5 or a multivitamin may be beneficial.

Ascorbic acid (vitamin C) levels below the mean (54) may indicate a less than optimum level of the antioxidant vitamin C. Individuals who consume large amounts of vitamin C can still have low values if the sample is taken 12 or more hours after intake. Supplementation with buffered vitamin C taken 2 or 3 times a day is suggested.

Slightly high 4-hydroxybutyric acid (75) may be due to the interference from closely related compounds or due to the use of 4-hydroxybutric acid (also called gamma-hydroxy butyric acid) as a supplement.

Low citramalic, 2-hydroxyphenylacetic, 4-hydroxyphenylacetic, 4-hydroxybenzoic, 4-hydroxyhippuric, 3-indoleacetic, glyceric, glycolic, oxalic, lactic, pyruvic, 3-Methylglutaric, 3-methylglutaconic, 2-hydroxybutyric, fumaric, malic, aconitic, quinolinic, kynurenic, thymine, ethylmalonic, methylsuccinic, adipic, suberic, glutaric, 3-hydroxy-3-methylglutaric, methylcitric, or orotic values have no known clinical significance.