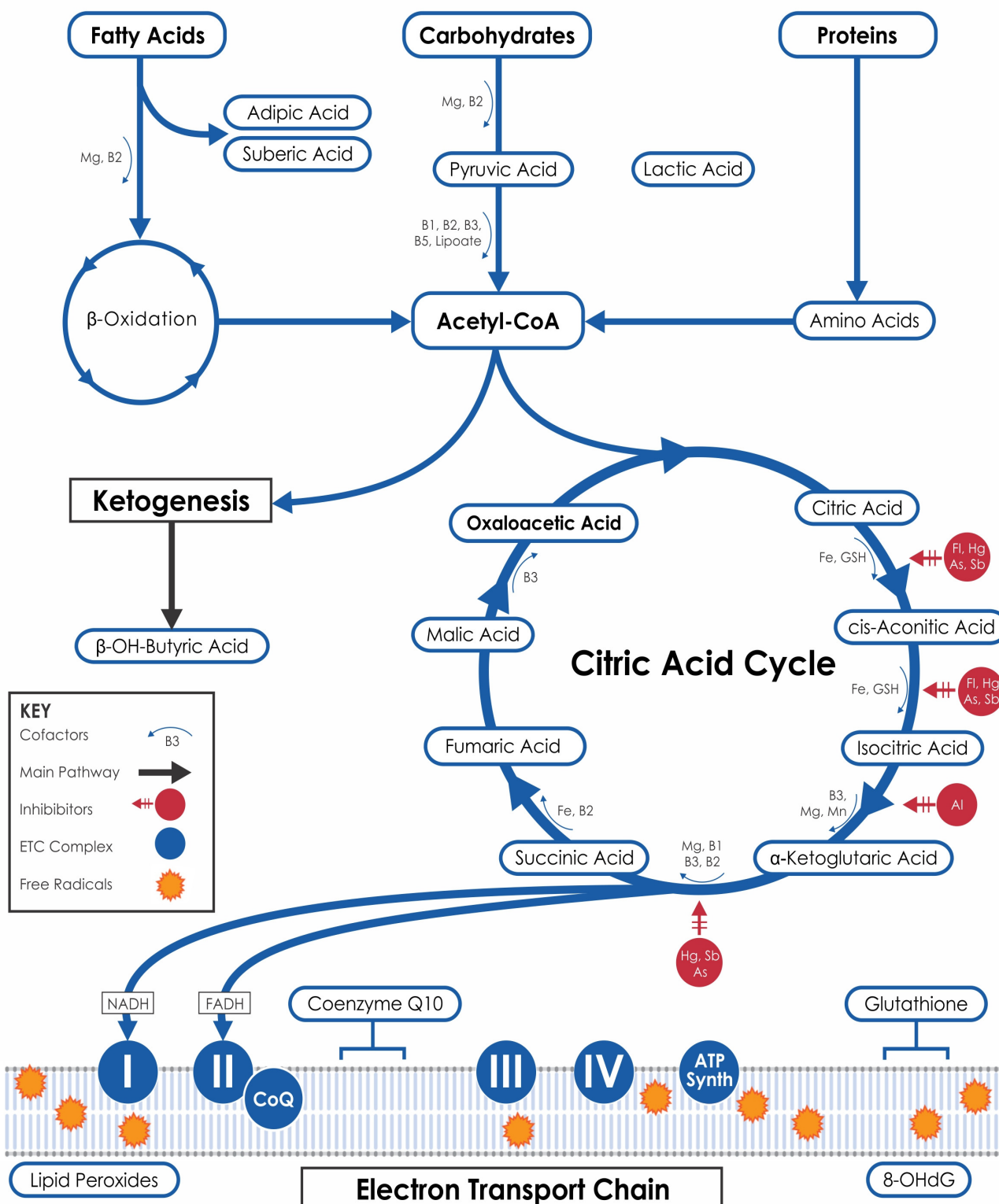


ORGANIC ACIDS METABOLOMIC MAPPING

Method: LCMS/MS/MS

Organic Acids Pathways



Nutrient Markers

URINE, SPOT

KETONE/FATTY ACID Metabolites

(Carnitine & B2)

1. Adipic Acid.	1.63	0.00 - 3.80 mmol/molCr	
2. Suberic Acid.	1.35	0.00 - 2.20 mmol/molCr	
3. Ethylmalonic Acid	2.42	0.00 - 5.80 mmol/molCr	
4. Pimelic Acid	2.0	0.0 - 4.0 mmol/molCr	
5. Methyl-Succinic Acid	3.97	0.00 - 10.80 mmol/molCr	

CARBOHYDRATE Metabolism/Glycolysis

(B1, B3, Cr, Lipoic Acid, CoQ10)

6. Pyruvic Acid.	3.62	0.00 - 8.70 mmol/molCr	
7. Lactic Acid.	4.87	0.00 - 48.00 mmol/molCr	
8. b-OH-Butyric Acid	0.43	0.00 - 3.10 mmol/molCr	
9. Glucose (OA)	0.1	0.1 - 1.1 mmol/L	

CITRIC ACID CYCLE Metabolites.

(B Comp., CoQ10, Amino Acids, Mg)

10. Citric Acid.	268.2	40.0 - 507.0 mmol/molCr	
11. cis-Aconitic Acid.	24.3	3.5 - 36.0 mmol/molCr	
12. Isocitric Acid.	37.7	5.0 - 65.0 mmol/molCr	
13. a-Ketoglutaric Acid.	28.27	4.00 - 52.00 mmol/molCr	
14. Succinic Acid	8.28	1.00 - 9.70 mmol/molCr	
15. Fumaric Acid.	4.54	0.00 - 8.60 mmol/molCr	
16. Malic Acid.	0.43	0.00 - 1.80 mmol/molCr	
17. b-OH-b-Methylglutaric Acid	0.36	0.00 - 8.50 mmol/molCr	

B-Complex Vitamins & Amino Acid Markers

(B1, B2, B3, B5, B6, Biotin)

18. a-Ketoisovaleric Acid	2.77	0.00 - 4.10 mmol/molCr	
19. a-Ketoisocaproic Acid	0.12	0.00 - 0.65 mmol/molCr	
20. a-Keto-b-Methylvaleric Acid	0.39	0.00 - 2.00 mmol/molCr	
21. Xanthurenic Acid	0.16	0.00 - 0.96 mmol/molCr	
22. beta-Hydroxyisovaleric Acid	3.00	0.00 - 29.00 mmol/molCr	

METHYLATION COFACTORS

(B12, Folate)

23. Methylmalonic Acid.	1.34	0.00 - 1.90 mmol/molCr	
24. Formiminoglutamic Acid **	<dl	0.0 - 1.5 mmol/molCr	

Cell Regulation Markers

NEUROTRANSMITTER METABOLISM

(Tyrosine, Tryptophan, B6, Antioxidants)

25. Homovanillic Acid (HVA)	1.85	0.10 - 5.30 mmol/molCr	
26. Vanillylmandelic Acid (VMA)	1.58	0.40 - 3.60 mmol/molCr	
27. 5HIAA	1.52	0.00 - 4.30 mmol/molCr	
28. Kynurenic Acid.	0.79	0.00 - 2.20 mmol/molCr	
29. Quinolinic Acid (OA)	3.07	0.00 - 9.10 mmol/molCr	
30. Picolinic Acid	0.1	0.0 - 10.3 mmol/molCr	
31. Cortisol (OA)	5.0	5.0 - 65.0 ng/mL	



Oxidative Damage/AntiOxidant Markers

(Vitamin C and Other Antioxidants)

32.	ParaHydroxyphenyllactate	2.37	0.00 - 3.90	mmol/molCr	
33.	8 OH-deoxyguanosine	2.1	0.0 - 2.7	ng/gCR	

Toxicants and Detoxification

DETOXIFICATION INDICATORS

(Arg, NAC, Met, Mg, Antioxidants)

34.	2-Methylhippuric Acid	<dl	0.00 - 0.77	mmol/molCr	
35.	Orotic Acid.	1.47	0.00 - 3.20	mmol/molCr	
36.	Glucaric Acid.	5.18	0.00 - 11.00	mmol/molCr	
37.	a-OH-Butyric Acid	4.09	0.00 - 6.90	mmol/molCr	
38.	Pyroglutamic Acid.	7.8	4.5 - 33.0	mmol/molCr	

Compounds of Bacterial or Yeast/Fungal Origin

BACTERIAL DYSBIOSIS MARKERS.

39.	Benzoate (OA)	<dl	0.00 - 9.30	mmol/molCr	
40.	Hippurate (OA)	233	0.0 - 603	mmol/molCr	
41.	Phenylacetate	1.5	0.0 - 4.2	mmol/molCr	
42.	Phenylpropionate	<dl	0.0 - 0.1	mmol/molCr	
43.	ParaHydroxyBenzoate	0.1	0.0 - 0.6	mmol/molCr	
44.	p-HydroxyPhenylacetate	10.8	0.0 - 14.6	mmol/molCr	
45.	Indoleacetic Acid	0.2	0.0 - 11.0	mmol/molCr	
46.	Tricarballoylate	0.11	0.00 - 0.44	mmol/molCr	

CLOSTRIDIAL SPECIES

48.	Dihydroxyphenylpropionic Acid	0.22	0.00 - 5.30	mmol/molCr	
49.	4-Cresol	1.0	0.0 - 1.7	ug/mgCR	
50.	3-OH-Propionic Acid	1.3	0.0 - 17.0	mmol/molCr	

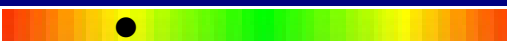
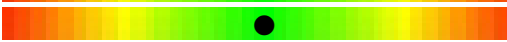
YEAST/FUNGAL DYSBIOSIS MARKERS.

51.	Arabinitol	31.4	0.0 - 36.0	mmol/molCr	
52.	Citramalic Acid	2.0	0.0 - 3.6	mmol/molCr	
53.	Tartaric Acid.	1.4	0.0 - 15.0	mmol/molCr	

Oxalate Metabolites

54.	Oxalic Acid	23.76	0.00 - 78.00	mmol/molCr	
55.	Glyceric Acid	0.4	0.0 - 6.0	mmol/molCr	
56.	Glycolic Acid	38.8	0.0 - 67.0	mmol/molCr	

Nutritional Markers

57.	Pyridoxic Acid (Vit B6)	3.5	0.7 - 34.0	mmol/molCr	
58.	Pantothenic Acid (Vit B5)	5.7	0.1 - 10.0	mmol/molCr	
59.	Glutaric Acid (Vit B2) **	0.4 *H	0.0 - 0.4	mmol/molCr	
60.	Ascorbic Acid (Vit C)	5.5	0.5 - 200	mmol/molCr	
61.	CoEnzyme-Q10 (CoQ10) **	1.99	0.10 - 5.00	mmol/molCr	
62.	N-Acetylcysteine (NAC)	0.25	0.02 - 0.28	mmol/molCr	
63.	Biotin (Vit H)	5.98	0.10 - 15.00	mmol/molCr	

Creatinine, Urine Spot.	4.7	2.5 - 19.2	mmol/L	
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Results reported as <dl = Less than detectable limit ** A high value for this marker may indicate a deficiency of this vitamin



Nutritional Guide

Nutrient	Adult Dose Range	Units	Clinician Notes
Vitamin-C	1500.0	mg	
Vitamin-B1	150.0	mg	
Vitamin-B2	200.0	mg	
Vitamin-B3	500.0	mg	
Vitamin-B5	200.0	mg	
Vitamin-B6	27.5	mg	
Vitamin-B12	450.0	ug	
Biotin.	52.5	ug	
Folinic Acid.	500.0	ug	
Manganese.	20.0	mg	
Magnesium .	600.0	mg	
Coenzyme Q10.	300.0	mg	
alpha Lipoic Acid.	600.0	mg	
Calcium-D-glucurate.	500.0	mg	
Acetyl-L-Carnitine.	600.0	mg	
N-Acetylcysteine.	600.0	mg	
Glutathione.	425.0	mg	
5-hydroxyTryptophan (5-HTP).	62.5	mg	
Aspartic Acid.	1000.0	mg	
L-Arginine.	2000.0	mg	
Glycine .	1000.0	mg	
Serine.	875.0	mg	
Tryptophan.	375.0	mg	
Probiotics (Multistain)	60.0	billion CFU	

Disclaimer:

Supplement recommendations are based on the Organic Acid test results. The prescribing health practitioner must take into consideration the age, weight, sex, and pregnancy or lactation state. In addition, consider clinical state, medication regime, associated drug-nutrient depletion and allergies. The doses listed above are considered optimal, based on lab results and do not apply to specific disease conditions where doses may need to be altered. The vitamins, minerals or amino acids listed are elemental quantities. Use clinical discretion when choosing the right salt with the guidance of your compounding health professional. For example, Magnesium may be prescribed as a glycinate for its calming effect or threonate may be used for a Magnesium that crosses the blood-brain-barrier.

References:

Laboratory Evaluations for Integrative and Functional Medicine by Richard Lord.
J.Alexander Bralley; Textbook of Nutritional Medicine by Alan Gaby.



Laboratory Comments

Ketone/FA Metabolites Comment

Organic acids provide functional markers for the metabolic effects of micronutrient adequacy, toxic exposure, neuroendocrine activity, intestinal bacterial and fungal overgrowth. Organic acid testing indicates the need for nutrients, diet modification, detoxification, antioxidant protection or further testing.

In a healthy state, organic acids are excreted in the urine at low concentrations. Low range results may be associated with hypometabolic compensatory states. Compensatory responses include hormonal secretions and cytokine responses that can slow or reverse deviations from median or normal physiologic states.

The Krebs cycle is a process of conversion of fats, carbohydrates and protein to mitochondrial energy, ATP.

Metabolic blocks in the Krebs cycle due to insufficient enzymes or cofactors will result in the elevation of organic acids that accumulate and spill into urine.

FATTY ACID METABOLISM:

Adipate, suberate, pimelate, Ethylmalonate and 2-methylsuccinate are organic compounds from fatty acid metabolism. Long chain fatty acids (LCFAs) undergo beta-oxidation in the mitochondria which is carnitine dependant. Dietary fat is broken down to produce free fatty acids, energy substrates using pathways that require carnitine and vitamin B2 (Riboflavin).

Low levels of Ethylmalonate with high adipate and suberate may be associated with carnitine deficient hypometabolic states where multiple amino acid catabolic pathways are restricted due to mitochondrial retraction.

Carbohydrate Metabolism Comment

CARBOHYDRATE METABOLISM/GLYCOLYSIS:

Dietary carbohydrates are broken down into Glucose and other sugars where carbohydrate breakdown products, pyruvate and lactate are formed. Pyruvate enters the Krebs cycle via dehydrogenase enzymes which require vitamin B1 (thiamine), vitamin B2 (riboflavin), vitamin B3 (niacin), vitamin B5 (pantothenic acid), and lipoic Acid to function correctly. Review Vitamin B Levels in conjunction with Pyruvate and Lactate levels.

In the absence of these nutrients, lactate builds up leading to lactic acidosis. Elevated pyruvate and lactate can indicate a need for lipoic acid.

Cit Acid Cycle Metabs Comment

The Citric Acid Cycle is the pathway for energy released from food components and the source of anabolic molecules to support organ maintenance and neurological function. Therefore, the citric acid cycle serves both anabolic and catabolic functions representing the crossroads of food conversion and utilisation.

B-Vitamins/Amino Acids Comment

B-COMPLEX VITAMIN MARKERS:

B-Complex Vitamin Markers are metabolic intermediates in the degradation of amino acids. When hepatic enzymes remove branched-chain amino acids, they form keto acids.

B-complex vitamins are essential for many in metabolic functions in the body used to extract energy from cellular health, remove toxins, and maintain the immune system.

B-Complex vitamin deficiencies produce symptoms associated with homocysteinemia effects or mitochondriopathy-associated symptoms which include periodic weakness, nausea, fatigue, attention deficit or Reye syndrome.

Neurotransmitter Metabolism Comment

5HIAA IS WITHIN RANGE:



5HIAA is the major metabolite of Serotonin.

Detoxification/Toxicants Comment

OXIDATIVE DAMAGE AND ANTIOXIDANT MARKERS:

The assessment of protection from oxidant and ammonia challenge should be of priority when detoxification requirement is suspected. Oxidative stress has been associated with a variety of diseases like diabetes, cancer, neurodegenerative disorders and aging.

DETOXIFICATION INDICATORS:

The organic acids of this group serve as biomarkers of detoxification status or biotransformation capacities, distinct parts of the detoxification system, providing insight about both exogenous toxin accumulation and endogenous detoxification responses.

Elevations in toxicant and detoxification markers reveal aspects of xenobiotic exposure, endogenous toxins and detoxification functions.