



Metabolic Analysis Profile

Physician Copy



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Asheville, NC 28801
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Patient: **JOHN DOE**
DOB: October 31, 2008
Sex: M
MRN:

Order Number: **D5240150**
Completed: March 25, 2011
Received: March 24, 2011
Collected: March 24, 2011

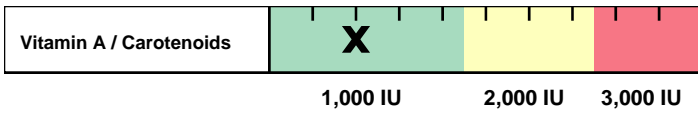
Results Overview

Normal	Borderline	High Need	Supplementation for High Need
Antioxidants			
Vitamin A / Carotenoids			
Vitamin C			
Vitamin E / Tocopherols			
B-Vitamins			
Thiamin - B1		Riboflavin - B2	Riboflavin - B2 - Dose = 5 mg
	Niacin - B3		
Pyridoxine - B6			
Biotin - B7			
	Folic Acid - B9		
		Cobalamin - B12	Cobalamin - B12 - Dose = 50 mcg
Minerals			
		Magnesium	Magnesium - Dose = 200 mg
Manganese			
Molybdenum			
	Zinc		

Metabolic Analysis Profile Interpretation At-A-Glance

Nutritional Needs

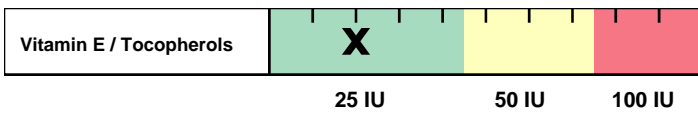
Antioxidants



- ▶ Beta-carotene & other carotenoids are converted to vitamin A (retinol), involved in vision, antioxidant & immune function, gene expression & cell growth.
- ▶ Vitamin A deficiency may occur with chronic alcoholism, zinc deficiency, hypothyroidism, or oral contraceptives containing estrogen & progestin.
- ▶ Deficiency may result in night blindness, impaired immunity, healing & tissue regeneration, increased risk of infection, leukoplakia or keratosis.
- ▶ Food sources include cod liver oil, fortified cereals & milk, eggs, sweet potato, pumpkin, carrot, cantaloupe, mango, spinach, broccoli, kale & butternut squash.



- ▶ Vitamin C is an antioxidant (also used in the regeneration of other antioxidants). It is involved in cholesterol metabolism, the production & function of WBCs and antibodies, and the synthesis of collagen, norepinephrine and carnitine.
- ▶ Deficiency may occur with oral contraceptives, aspirin, diuretics or NSAIDs.
- ▶ Deficiency can result in scurvy, swollen gingiva, periodontal destruction, loose teeth, sore mouth, soft tissue ulcerations, or increased risk of infection.
- ▶ Food sources include oranges, grapefruit, strawberries, tomato, sweet red pepper, broccoli and potato.



- ▶ Alpha-tocopherol (body's main form of vitamin E) functions as an antioxidant, regulates cell signaling, influences immune function and inhibits coagulation.
- ▶ Deficiency may occur with malabsorption, cholestyramine, colestipol, isoniazid, orlistat, olestra and certain anti-convulsants (e.g., phenobarbital, phenytoin).
- ▶ Deficiency may result in peripheral neuropathy, ataxia, muscle weakness, retinopathy, and increased risk of CVD, prostate cancer and cataracts.
- ▶ Food sources include oils (olive, soy, corn, canola, safflower, sunflower), eggs, nuts, seeds, spinach, carrots, avocado, dark leafy greens and wheat germ.

Key

- ▶ Function
- ▶ Causes of Deficiency
- ▶ Complications of Deficiency
- ▶ Food Sources

Metabolic Analysis Profile Interpretation At-A-Glance

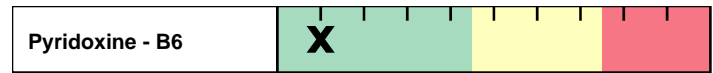
Nutritional Needs

B-Vitamins



1 mg 2 mg 3 mg

- ▶ B1 is a required cofactor for enzymes involved in energy production from food, and for the synthesis of ATP, GTP, DNA, RNA and NADPH.
- ▶ Low B1 can result from chronic alcoholism, diuretics, digoxin, oral contraceptives and HRT, or large amounts of tea & coffee (contain anti-B1 factors).
- ▶ B1 deficiency may lead to dry beriberi (e.g., neuropathy, muscle weakness), wet beriberi (e.g., cardiac problems, edema), encephalopathy or dementia.
- ▶ Food sources include lentils, whole grains, wheat germ, Brazil nuts, peas, organ meats, brewer's yeast, blackstrap molasses, spinach, milk & eggs.



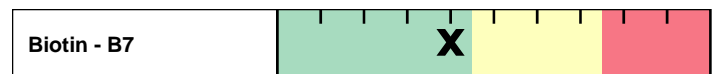
1 mg 2 mg 5 mg

- ▶ B6 (as P5P) is a cofactor for enzymes involved in glycogenolysis & gluconeogenesis, and synthesis of neurotransmitters, heme, B3, RBCs and nucleic acids.
- ▶ Low B6 may result from chronic alcoholism, long-term diuretics, estrogens (oral contraceptives and HRT), anti-TB meds, penicillamine, L-DOPA or digoxin.
- ▶ B6 deficiency may result in neurologic symptoms (e.g., irritability, depression, seizures), oral inflammation, impaired immunity or increased homocysteine.
- ▶ Food sources include poultry, beef, beef liver, fish, whole grains, wheat germ, soybean, lentils, nuts & seeds, potato, spinach and carrots.



1 mg 2 mg 5 mg

- ▶ B2 is a key component of enzymes involved in antioxidant function, energy production, detoxification, methionine metabolism and vitamin activation.
- ▶ Low B2 may result from chronic alcoholism, some anti-psychotic medications, oral contraceptives, tricyclic antidepressants, quinacrine or adriamycin.
- ▶ B2 deficiency may result in oxidative stress, mitochondrial dysfunction, low uric acid, low B3 or B6, high homocysteine, anemia or oral & throat inflammation.
- ▶ Food sources include milk, cheese, eggs, whole grains, beef, chicken, wheat germ, fish, broccoli, asparagus, spinach, mushrooms and almonds.



50 mcg 100 mcg 200 mcg

- ▶ Biotin is a cofactor for enzymes involved in functions such as fatty acid (FA) synthesis, mitochondrial FA oxidation, gluconeogenesis, and DNA replication & transcription.
- ▶ Deficiency may result from certain inborn errors, chronic intake of raw egg whites, long-term TPN use, anticonvulsants, high-dose B5, sulfa drugs & other antibiotics.
- ▶ Low levels may result in neurologic symptoms (e.g., paresthesias, depression), hair loss, scaly rash on face or genitals or impaired immunity.
- ▶ Food sources include yeast, whole grains, wheat germ, eggs, cheese, liver, meats, fish, wheat, nuts & seeds, avocado, raspberries, sweet potato and cauliflower.



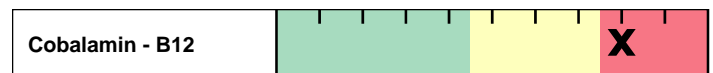
10 mg 20 mg 30 mg

- ▶ B3 is used to form NAD and NADP, involved in energy production from food, fatty acid & cholesterol synthesis, cell signaling, DNA repair & cell differentiation.
- ▶ Low B3 may result from deficiencies of tryptophan (B3 precursor), B6, B2 or Fe (cofactors in B3 production), or from long-term isoniazid or oral contraceptive use.
- ▶ B3 deficiency may result in pellagra (dermatitis, diarrhea, dementia), neurologic symptoms (e.g., depression, memory loss), bright red tongue or fatigue.
- ▶ Food sources include poultry, beef, organ meats, fish, whole grains, peanuts, seeds, lentils, brewer's yeast and lima beans.



200 mcg 300 mcg 400 mcg

- ▶ Folic acid plays a key role in coenzymes involved in DNA and SAME synthesis, methylation, nucleic acids & amino acid metabolism and RBC production.
- ▶ Low folate may result from alcoholism, high-dose NSAIDs, diabetic meds, H2 blockers, some diuretics and anti-convulsants, SSRIs, methotrexate, trimethoprim, pyrimethamine, triamterene, sulfasalazine or cholestyramine.
- ▶ Folate deficiency can result in anemia, fatigue, low methionine, increased homocysteine, impaired immunity, heart disease, birth defects and CA risk.
- ▶ Food sources include fortified grains, green vegetables, beans & legumes.



10 mcg 25 mcg 50 mcg

- ▶ B12 plays important roles in energy production from fats & proteins, methylation, synthesis of hemoglobin & RBCs, and maintenance of nerve cells, DNA & RNA.
- ▶ Low B12 may result from alcoholism, malabsorption, hypochlorhydria (e.g., from atrophic gastritis, H. pylori infection, pernicious anemia, H2 blockers, PPIs), vegan diets, diabetic meds, cholestyramine, chloramphenicol, neomycin or colchicine.
- ▶ B12 deficiency can lead to anemia, fatigue, neurologic symptoms (e.g., paresthesias, memory loss, depression, dementia), methylation defects or chromosome breaks.
- ▶ Food sources include shellfish, red meat poultry, fish, eggs, milk and cheese.

Metabolic Analysis Profile Interpretation At-A-Glance

Nutritional Needs

Minerals



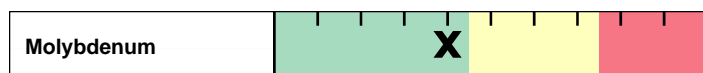
1 mg 2 mg 3 mg

- ▶ Manganese plays an important role in antioxidant function, gluconeogenesis, the urea cycle, cartilage & bone formation, energy production and digestion.
- ▶ Impaired absorption of Mn may occur with excess intake of Fe, Ca, Cu, folic acid, or phosphorous compounds, or use of long-term TPN, Mg-containing antacids or laxatives.
- ▶ Deficiency may result in impaired bone/connective tissue growth, glucose & lipid dysregulation, infertility, oxidative stress, inflammation or hyperammonemia.
- ▶ Food sources include whole grains, legumes, dried fruits, nuts, dark green leafy vegetables, liver, kidney and tea.



100 mg 150 mg 200 mg

- ▶ Magnesium is involved in >300 metabolic reactions. Key areas include energy production, bone & ATP formation, muscle & nerve conduction and cell signaling.
- ▶ Deficiency may occur with malabsorption, alcoholism, hyperparathyroidism, renal disorders (wasting), diabetes, diuretics, digoxin or high doses of zinc.
- ▶ Low Mg may result in muscle weakness/spasm, constipation, depression, hypertension, arrhythmias, hypocalcemia, hypokalemia or personality changes.
- ▶ Food sources include dark leafy greens, oatmeal, buckwheat, unpolished grains, chocolate, milk, nuts & seeds, lima beans and molasses.



25 mcg 50 mcg 75 mcg

- ▶ Molybdenum is a cofactor for enzymes that convert sulfites to sulfate, and nucleotides to uric acid, and that help metabolize aldehydes & other toxins.
- ▶ Low Mo levels may result from long-term TPN that does not include Mo.
- ▶ Mo deficiency may result in increased sulfite, decreased plasma uric acid (and antioxidant function), deficient sulfate, impaired sulfation (detoxification), neurologic disorders or brain damage (if severe deficiency).
- ▶ Food sources include buckwheat, beans, grains, nuts, beans, lentils, meats and vegetables (although Mo content of plants depends on soil content).



3 mg 5 mg 10 mg

- ▶ Zinc plays a vital role in immunity, protein metabolism, heme synthesis, growth & development, reproduction, digestion and antioxidant function.
- ▶ Low levels may occur with malabsorption, alcoholism, chronic diarrhea, diabetes, excess Cu or Fe, diuretics, ACE inhibitors, H2 blockers or digoxin.
- ▶ Deficiency can result in hair loss and skin rashes, also impairments in growth & healing, immunity, sexual function, taste & smell and digestion.
- ▶ Food sources include oysters, organ meats, soybean, wheat germ, seeds, nuts, red meat, chicken, herring, milk, yeast, leafy and root vegetables.

Digestive Support



5 B CFU 10 B CFU 25 B CFU

- ▶ Probiotics have many functions. These include: production of some B vitamins and vitamin K; enhancement of digestion & absorption; decreasing severity of diarrheal illness; modulation of immune function & intestinal permeability.
- ▶ Alterations of gastrointestinal microflora may result from C-section delivery, antibiotic use, improved sanitation, decreased consumption of fermented foods, and use of certain drugs.
- ▶ Some of the diseases associated with microflora imbalances include: IBS, IBD, fibromyalgia, chronic fatigue syndrome, obesity, atopic illness, colic and cancer.
- ▶ Food sources rich in probiotics are yogurt, kefir and fermented foods.



0 IU 5,000 IU 10,000 IU

- ▶ Pancreatic enzymes are secreted by the exocrine glands of the pancreas and include protease/peptidase, lipase and amylase.
- ▶ Pancreatic exocrine insufficiency may be primary or secondary in nature. Any indication of insufficiency warrants further evaluation for underlying cause (i.e., celiac disease, small intestine villous atrophy, small bowel bacterial overgrowth).
- ▶ A high functional need for digestive enzymes suggests that there is an impairment related to digestive capacity.
- ▶ Determining the strength of the pancreatic enzyme support depends on the degree of functional impairment. Supplement potency is based on the lipase units present in both prescriptive and non-prescriptive agents.

Metabolic Analysis Profile Interpretation At-A-Glance

Functional Imbalances



- Mitochondria are a primary site of generation of reactive oxygen species. Oxidative damage is considered an important factor in decline of physiologic function that occurs with aging and stress.
- Mitochondrial defects have been identified in cardiovascular disease, fatigue syndromes, neurologic disorders such as Parkinson's and Alzheimer's disease, as well as a variety of genetic conditions. Common nutritional deficiencies can impair mitochondrial efficiency.

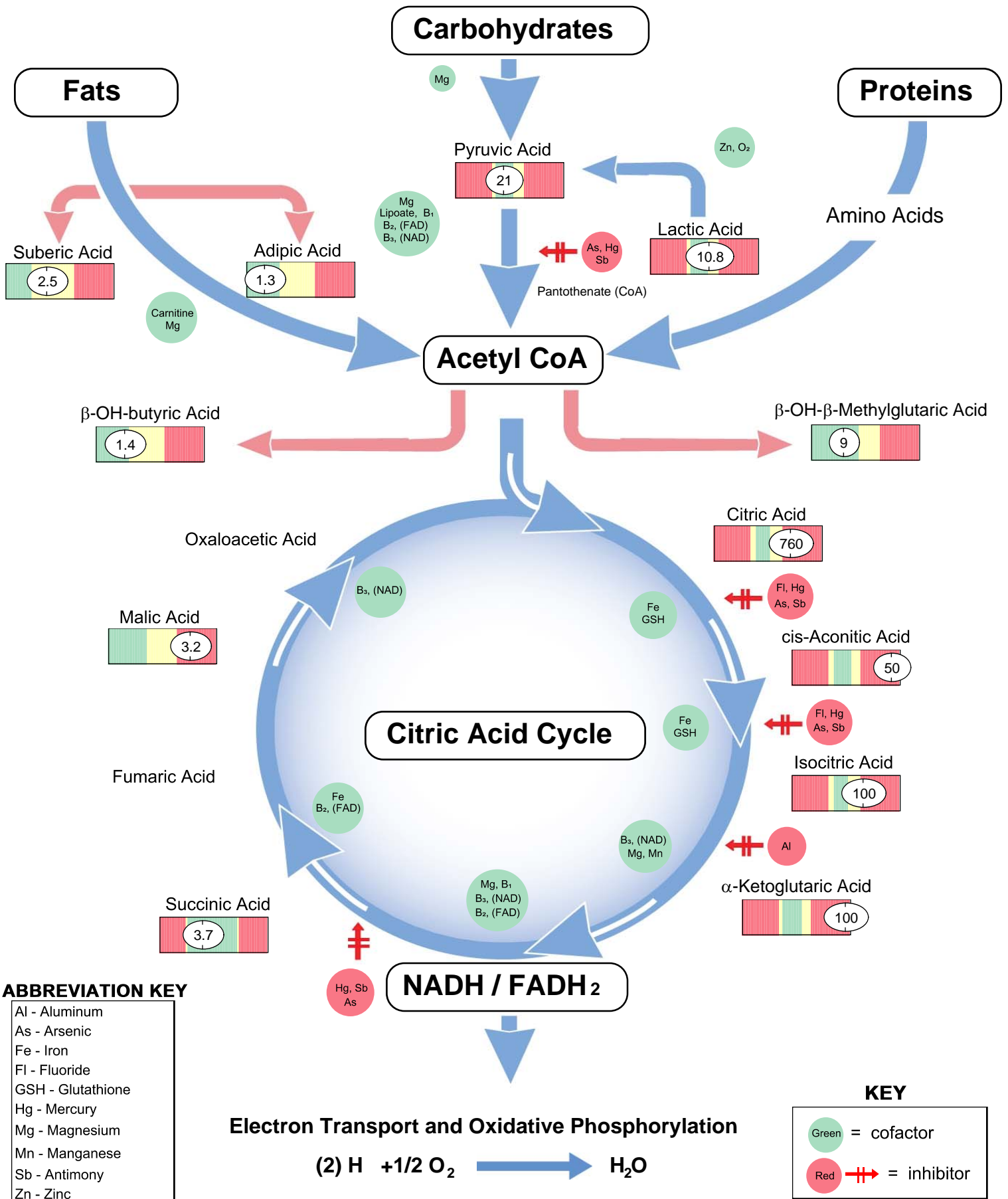


- Methyl tert-Butyl Ether (MTBE) is a common gasoline additive used to increase octane ratings, and has been found to contaminate ground water supplies where gasoline is stored. Inhalation of MTBE may cause nose and throat irritation, as well as headaches, nausea, dizziness and mental confusion. Animal studies suggest that drinking MTBE may cause gastrointestinal irritation, liver and kidney damage and nervous system effects.
- Styrene is classified by the US EPA as a "potential human carcinogen," and is found widely distributed in commercial products such as rubber, plastic, insulation, fiberglass, pipes, food containers and carpet backing.
- Levels of these toxic substances should be examined within the context of the body's functional capacity for methylation and need for glutathione.



- Methylation is an enzymatic process that is critical for both synthesis and inactivation. DNA, estrogen and neurotransmitter metabolism are all dependent on appropriate methylation activity.
- B vitamins and other nutrients (methionine, magnesium, selenium) functionally support catechol-O-methyltransferase (COMT), the enzyme responsible for methylation.

Krebs Cycle At-A-Glance



All biomarkers reported in mmol/mol creatinine unless otherwise noted.

Metabolic Analysis Markers

Malabsorption and Dysbiosis Markers

Malabsorption Markers	Reference Range
Indoleacetic Acid (IAA)	4.0 <= 4.2
Phenylacetic Acid (PAA)	<dl <= 0.15

Bacterial Dysbiosis Markers	Reference Range
Dihydroxyphenylpropionic Acid (DHPPA)	18.9 <= 12.3
3-Hydroxyphenylacetic Acid	5.8 <= 9.2
4-Hydroxyphenylacetic Acid	19 <= 37
Benzoic Acid	0.10 <= 0.10
Hippuric Acid	340 <= 921

Yeast / Fungal Dysbiosis Markers	Reference Range
Arabinose	150 <= 132
Citramalic Acid	2.6 <= 5.3
Tartaric Acid	5 <= 20

Cellular Energy & Mitochondrial Metabolites

Carbohydrate Metabolism	Reference Range
Lactic Acid	10.8 3.7-14.6
Pyruvic Acid	21 12-39
β-OH-Butyric Acid (BHBA)	1.4 <= 3.4

Energy Metabolism	Reference Range
Citric Acid	760 62-648
Cis-Aconitic Acid	50 13-33
Isocitric Acid	100 38-97
α-Ketoglutaric Acid (AKG)	100 12-55
Succinic Acid	3.7 0.8-10.4
Malic Acid	3.2 <= 2.7
β-OH-β-Methylglutaric Acid (HMG)	9 <= 19

Fatty Acid Metabolism	Reference Range
Adipic Acid	1.3 <= 5.0
Suberic Acid	2.5 <= 4.2

Creatinine Concentration

Reference Range
Creatinine ♦ 4.1 3.1-19.5 mmol/L

Neurotransmitter Metabolites

Reference Range
Vanilmandelic Acid 4.2 1.5-5.0
Homovanillic Acid 14.7 1.8-8.6
5-OH-indoleacetic Acid 24.2 6.4-24.3
3-Methyl-4-OH-phenylglycol 0.13 0.07-0.41
Kynurenic Acid 8.7 <= 9.2
Quinolinic Acid 4.2 <= 11.6
Kynurenic / Quinolinic Ratio 2.07 >= 0.46

Vitamin Markers

Reference Range
α-Ketoadipic Acid 1.9 <= 2.1
α-Ketoisovaleric Acid <dl <= 0.85
α-Ketoisocaproic Acid <dl <= 0.91
α-Keto-β-Methylvaleric Acid <dl <= 2.3
Formiminoglutamic Acid (FIGlu) 0.6 <= 1.8
Glutaric Acid 0.97 <= 0.92
Isovalerylglycine 1.8 <= 5.4
Methylmalonic Acid 2.7 <= 2.2
Xanthurenic Acid 0.59 <= 1.07
3-Hydroxypropionic Acid 15 6-23
3-Hydroxyisovaleric Acid 25 <= 38

Toxin & Detoxification Markers

Reference Range
α-Ketophenylacetic Acid (from Styrene) 0.33 <= 0.50
α-Hydroxyisobutyric Acid (from MTBE) 7.5 <= 8.7
Orotic Acid 0.81 0.38-0.91
Pyroglutamic Acid 68 22-64

Tyrosine Metabolism

Reference Range
Homogentisic Acid <dl <= 33
2-Hydroxyphenylacetic Acid 0.96 <= 0.99

Metabolic Analysis Reference Ranges are Age Specific

The performance characteristics of all assays have been verified by Genova Diagnostics, Inc. Unless otherwise noted with ♦ as cleared by the U.S. Food and Drug Administration, assays are For Research Use Only.