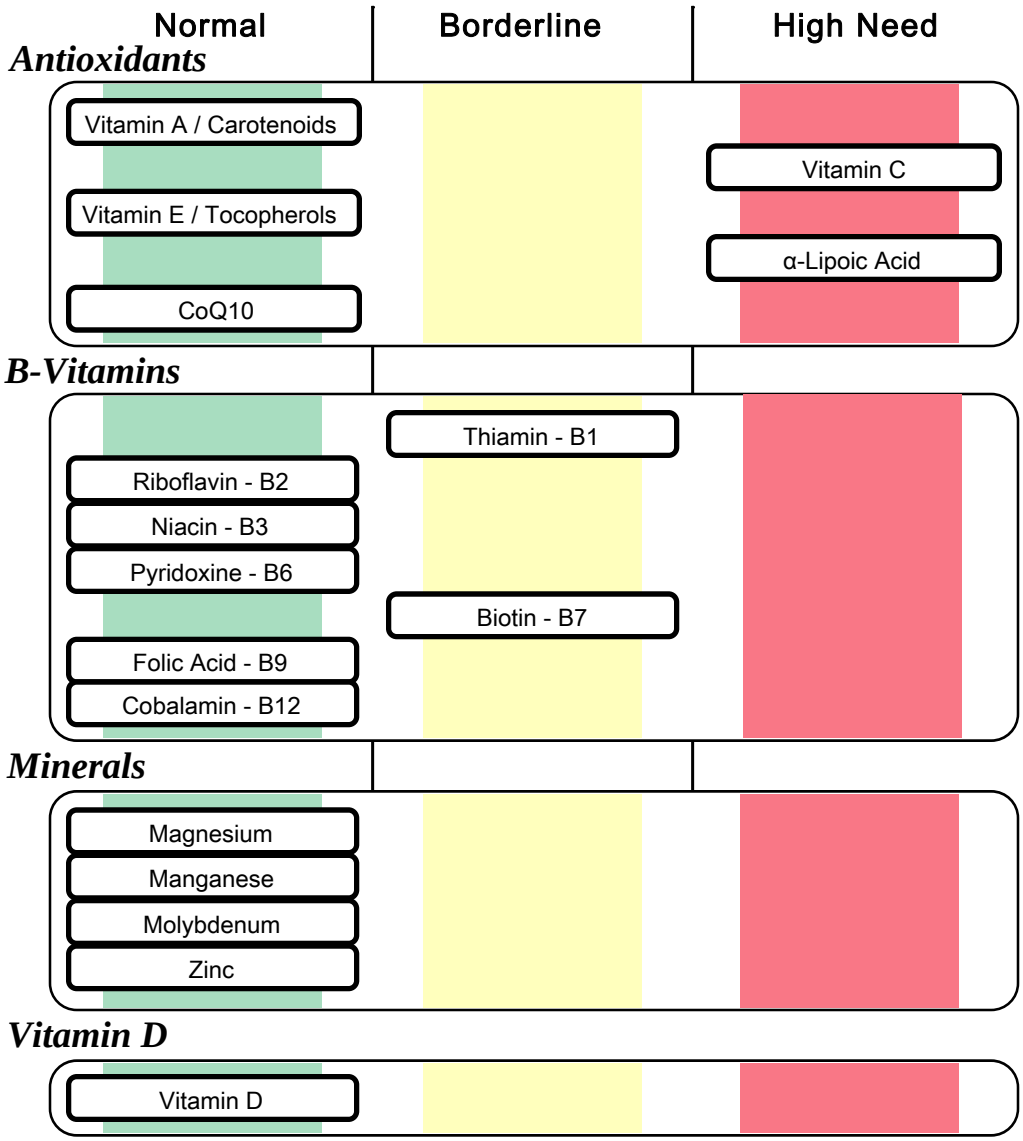
Genova Diagnostics® Europe
Parkgate House
356 West Barnes Lane
New Malden, Surrey KT3 6NB

63 Zillicoa Street
Asheville, NC 28801 USA

NutrEval Results Overview



Supplementation for High Need

Vitamin C - Dose = 1,000 mg

α-Lipoic Acid - Dose = 200 mg

SUGGESTED SUPPLEMENT SCHEDULE

Supplements	Daily Recommended Intake (DRI)	Patient's Daily Recommendations	Provider Daily Recommendations
Antioxidants			
Vitamin A / Carotenoids	3,000 IU	3,000 IU	
Vitamin C	90 mg	1,000 mg	
Vitamin E / Tocopherols	22 IU	100 IU	
α-Lipoic Acid		200 mg	
CoQ10		30 mg	
B-Vitamins			
Thiamin - B1	1.2 mg	25 mg	
Riboflavin - B2	1.3 mg	10 mg	
Niacin - B3	16 mg	20 mg	
Pyridoxine - B6	1.3 mg	10 mg	
Biotin - B7	30 mcg	200 mcg	
Folic Acid - B9	400 mcg	400 mcg	
Cobalamin - B12	2.4 mcg	100 mcg	
Minerals			
Magnesium	420 mg	400 mg	
Manganese	2.3 mg	3.0 mg	
Molybdenum	45 mcg	75 mcg	
Zinc	11 mg	10 mg	
Essential Fatty Acids			
Omega-3 Oils	500 mg	500 mg	
Digestive Support			
Probiotics		25 billion CFU	
Pancreatic Enzymes		5,000 IU	
Other Vitamins			
Vitamin D	600 IU	1,000 IU	

Amino Acid	mg/day	Amino Acid	mg/day
Arginine	0	Methionine	0
Asparagine	41	Phenylalanine	0
Cysteine	0	Serine	0
Glutamine	742	Taurine	0
Glycine	1,349	Threonine	0
Histidine	189	Tryptophan	0
Isoleucine	0	Tyrosine	292
Leucine	0	Valine	225
Lysine	1,122		

Recommendations for age and gender-specific supplementation are set by comparing levels of nutrient functional need to optimal levels as described in the peer-reviewed literature. They are provided as guidance for short-term support of nutritional deficiencies only.

The Suggested Supplemental Schedule is provided at the request of the ordering practitioner. Any application of it as a therapeutic intervention is to be determined by the ordering practitioner.

Key

Normal | Borderline | High Need

NutrEval FMV amino acids — Interpretation At-A-Glance

Nutritional Needs

Antioxidants

Vitamin A / Carotenoids

- 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.

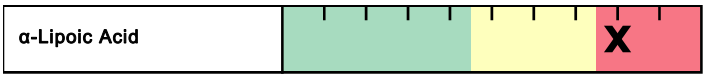
Vitamin C

- 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.

Vitamin E / Tocopherols

- 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.

α-Lipoic Acid



- α-Lipoic acid plays an important role in energy production, antioxidant activity (including the regeneration of vitamin C and glutathione), insulin signaling, cell signaling and the catabolism of α-keto acids and amino acids.
- High biotin intake can compete with lipoic acid for cell membrane entry.
- Optimal levels of α-lipoic acid may improve glucose utilization and protect against diabetic neuropathy, vascular disease and age-related cognitive decline.
- Main food sources include organ meats, spinach and broccoli. Lesser sources include tomato, peas, Brussels sprouts and brewer's yeast.

CoQ10

- CoQ10 is a powerful antioxidant that is synthesized in the body and contained in cell membranes. CoQ10 is also essential for energy production & pH regulation.
- CoQ10 deficiency may occur with HMG-CoA reductase inhibitors (statins), several anti-diabetic medication classes (biguanides, sulfonylureas) or beta-blockers.
- Low levels may aggravate oxidative stress, diabetes, cancer, congestive heart failure, cardiac arrhythmias, gingivitis and neurologic diseases.
- Main food sources include meat, poultry, fish, soybean, canola oil, nuts and whole grains. Moderate sources include fruits, vegetables, eggs and dairy.

Glutathione

- Glutathione (GSH) is composed of cysteine, glutamine & glycine. GSH is a source of sulfate and plays a key role in antioxidant activity and detoxification of toxins.
- GSH requirement is increased with high-fat diets, cigarette smoke, cystinuria, chronic alcoholism, chronic acetaminophen use, infection, inflammation and toxic exposure.
- Deficiency may result in oxidative stress & damage, impaired detoxification, altered immunity, macular degeneration and increased risk of chronic illness.
- Food sources of GSH precursors include meats, poultry, fish, soy, corn, nuts, seeds, wheat germ, milk and cheese.

Plant-based Antioxidants

- Oxidative stress is the imbalance between the production of free radicals and the body's ability to readily detoxify these reactive species and/or repair the resulting damage with anti-oxidants.
- Oxidative stress can be endogenous (energy production and inflammation) or exogenous (exercise, exposure to environmental toxins).
- Oxidative stress has been implicated clinically in the development of neurodegenerative diseases, cardiovascular diseases and chronic fatigue syndrome.
- Antioxidants may be found in whole food sources (e.g., brightly colored fruits & vegetables, green tea, turmeric) as well as nutraceuticals (e.g., resveratrol, EGCG, lutein, lycopene, ginkgo, milk thistle, etc.).

Key

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

NutrEval FMV amino acids

Interpretation At-A-Glance

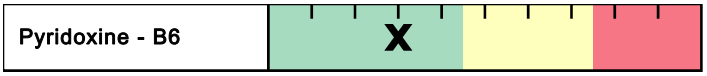
Nutritional Needs

B-Vitamins

Thiamin - B1

- 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.

Pyridoxine - B6



- 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.

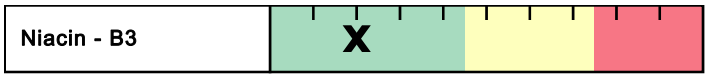
Riboflavin - B2

- 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.

Biotin - B7

- Biotin is a cofactor for enzymes involved in functions such as fatty acid 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, 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.

Niacin - B3

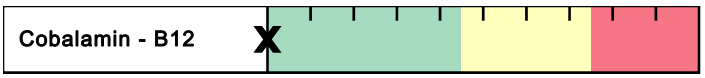


- B3 is used to form NAD and NADP, involved in energy production from food, fatty acid & cholesterol synthesis, cell signaling, DNA repair & cell differentiation.
- Low B3 may result from deficiencies of tryptophan (B3 precursor), B6, B2 or Fe (cofactors in B3 production), or from long-term isoniazid 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.

Folic Acid - B9

- 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.

Cobalamin - B12

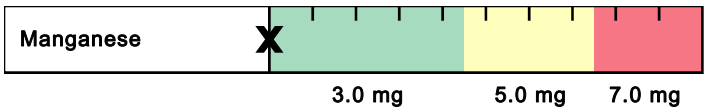


- B12 plays important roles in energy production from fats & proteins, methylation, synthesis of hemoglobin & RBCs, and maintenance of nerve cells, DNA & RNA.
- Low B12 may result from alcoholism, malabsorption, hypochlorhydria (e.g., from atrophic gastritis, H. pylori infection, pernicious anemia, H2 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.

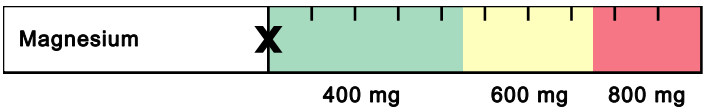
NutrEval FMV amino acids — Interpretation At-A-Glance

Nutritional Needs

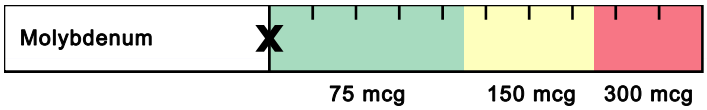
Minerals



- 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.



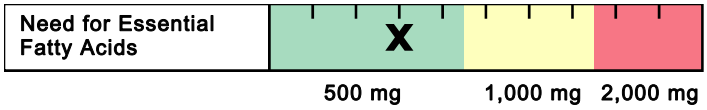
- Magnesium is involved in >300 metabolic reactions. Key areas include energy production, bone & ATP formation, muscle & nerve conduction and cell signaling.
- Deficiency may occur with malabsorption, alcoholism, hyperparathyroidism, renal disorders (wasting), diabetes, diuretics, digoxin or high doses 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.



- 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).

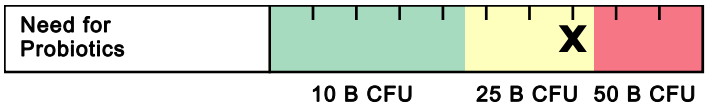
- Zinc plays a vital role in immunity, protein metabolism, heme synthesis, growth & development, reproduction, digestion and antioxidant function.
- Low levels may occur with malabsorption, alcoholism, chronic diarrhea, diabetes, excess Cu or Fe, diuretics, ACE inhibitors, H2 blockers or digoxin.
- Deficiency 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.

Essential Fatty Acids

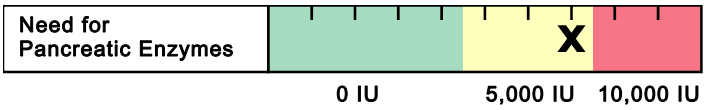


- Omega-3 (O3) and Omega-6 (O6) fatty acids are polyunsaturated fatty acids that cannot be synthesized by the human body. They are classified as essential nutrients and must be obtained from dietary sources.
- The standard American diet is much higher in O6 than O3 fatty acids. Deficiency of EFAs may result from poor dietary intake and/or poor conversion from food sources.
- EFA deficiency is associated with decreased growth & development of infants and children, dry skin/rash, poor wound healing, and increased risk of infection, cardiovascular and inflammatory diseases.
- Dietary sources of the O6 Linoleic Acid (LA) include vegetable oils, nuts, seeds and some vegetables. Dietary sources of the O3 a-Linolenic Acid (ALA) include flaxseeds, walnuts, and their oils. Fish (mackerel, salmon, sardines) are the major dietary sources of the O3 fatty acids EPA and DHA.

Digestive Support

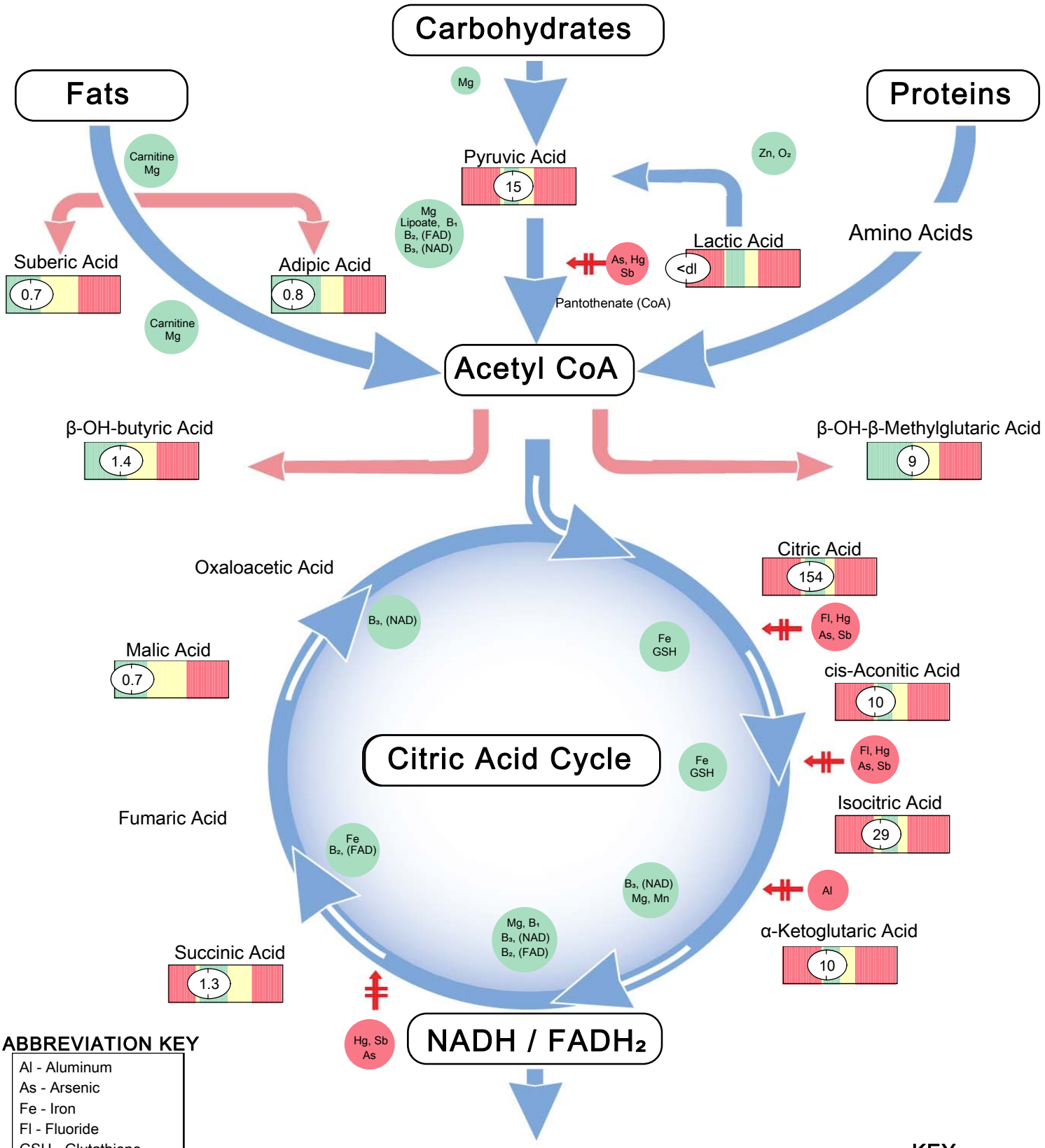


- Probiotics have many functions. These include: production of some B vitamins and vitamin K; enhance digestion & absorption; decrease severity of diarrheal illness; modulate of immune function & intestinal permeability.
- Alterations of gastrointestinal microflora may result from C-section delivery, 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.



- 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.

Krebs Cycle At-A-Glance



ABBREVIATION KEY

Al - Aluminum
As - Arsenic
Fe - Iron
Fl - Fluoride
GSH - Glutathione
Hg - Mercury
Mg - Magnesium
Mn - Manganese
Sb - Antimony
Zn - Zinc

Electron Transport and Oxidative Phosphorylation

(2) H + 1/2 O_2 → H_2O

KEY

Green = cofactor

Red = inhibitor

Metabolic Analysis Markers

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

Malabsorption and Dysbiosis Markers

Malabsorption Markers

		Reference Range
Indoleacetic Acid (IAA)	0.8	<= 4.2
Phenylacetic Acid (PAA)	0.08	<= 0.12

Bacterial Dysbiosis Markers

		Reference Range
Dihydroxyphenylpropionic Acid (DHPPA)	13.2	<= 5.3
3-Hydroxyphenylacetic Acid	3.1	<= 8.1
4-Hydroxyphenylacetic Acid	24	<= 29
Benzoic Acid	0.05	<= 0.05
Hippuric Acid	352	<= 603

Yeast / Fungal Dysbiosis Markers

		Reference Range
Arabinose	74	<= 96
Citramalic Acid	2.6	<= 5.8
Tartaric Acid	<dl	<= 15

Cellular Energy & Mitochondrial Metabolites

Carbohydrate Metabolism

		Reference Range
Lactic Acid	<dl	1.9-19.8
Pyruvic Acid	15	7-32
β-OH-Butyric Acid (BHBA)	1.4	<= 2.8

Energy Metabolism

		Reference Range
Citric Acid	154	40-520
Cis-Aconitic Acid	10	10-36
Isocitric Acid	29	22-65
α-Ketoglutaric Acid (AKG)	10	4-52
Succinic Acid	1.3	0.4-4.6
Malic Acid	0.7	<= 3.0
β-OH-β-Methylglutaric Acid (HMG)	9	<= 15

Fatty Acid Metabolism

		Reference Range
Adipic Acid	0.8	<= 2.8
Suberic Acid	0.7	<= 2.1

Creatinine Concentration

		Reference Range
Creatinine ◆	10.8	3.1-19.5 mmol/L

Neurotransmitter Metabolites

		Reference Range
Vanilmandelic Acid	0.9	0.4-3.6
Homovanillic Acid	5.5	1.2-5.3
5-OH-indoleacetic Acid	8.2	3.8-12.1
3-Methyl-4-OH-phenylglycol	0.06	0.02-0.22
Kynurenic Acid	2.0	<= 7.1
Quinolinic Acid	4.2	<= 9.1
Kynurenic / Quinolinic Ratio	0.48	>= 0.44

Vitamin Markers

		Reference Range
α-Ketoadipic Acid	0.4	<= 1.7
α-Ketoisovaleric Acid	0.53	<= 0.97
α-Ketoisocaproic Acid	0.43	<= 0.89
α-Keto-β-Methylvaleric Acid	1.1	<= 2.1
Formiminoglutamic Acid (FIGlu)	0.4	<= 1.5
Glutaric Acid	0.24	<= 0.51
Isovalerylglycine	1.1	<= 3.7
Methylmalonic Acid	1.1	<= 1.9
Xanthurenic Acid	0.66	<= 0.96
3-Hydroxypropionic Acid	7	5-22
3-Hydroxyisovaleric Acid	17	<= 29

Toxin & Detoxification Markers

		Reference Range
α-Ketophenylacetic Acid (from Styrene)	0.22	<= 0.46
α-Hydroxyisobutyric Acid (from MTBE)	5.0	<= 6.7
Orotic Acid	0.48	0.33-1.01
Pyroglutamic Acid	22	16-34

Tyrosine Metabolism

		Reference Range
Homogentisic Acid	32	<= 19
2-Hydroxyphenylacetic Acid	0.60	<= 0.76

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.

Amino Acids (FMV)

All biomarkers reported in micromol/gm creatinine unless otherwise noted.

Nutritionally Essential Amino Acids

Amino Acid	Reference Range
Arginine	10-64
Histidine	271-993
Isoleucine	17-52
Leucine	25-77
Lysine	34-226
Methionine	26-69
Phenylalanine	22-61
Taurine	80-545
Threonine	52-192
Tryptophan	23-88
Valine	19-53

Nonessential Protein Amino Acids

Amino Acid	Reference Range
Alanine	103-392
Asparagine	37-134
Aspartic Acid	27-74
Cysteine	19-70
Cystine	23-68
γ-Aminobutyric Acid	<= 23
Glutamic Acid	3-15
Glutamine	153-483
Proline	2-14
Tyrosine	28-113

Creatinine Concentration

	Reference Range
Creatinine ◆	3.1-19.5 mmol/L

Amino Acid 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.

Intermediary Metabolites

B Vitamin Markers	Reference Range
α-Aminoadipic Acid	11-73
α-Amino-N-butyric Acid	9-49
β-Aminoisobutyric Acid	19-163
Cystathionine	6-29
3-Methylhistidine	134-302

Urea Cycle Markers	Reference Range
Ammonia	12.0-41.0 mmol/g creatinine
Citrulline	9-40
Ornithine	3-16
Urea ◆	150-380 mmol/g creatinine

Glycine/Serine Metabolites	Reference Range
Glycine	434-1,688
Serine	135-426
Ethanolamine	156-422
Phosphoethanolamine	14-50
Phosphoserine	26-64
Sarcosine	<= 41

Dietary Peptide Related Markers

	Reference Range
Anserine (dipeptide)	8-118
Carnosine (dipeptide)	12-120
1-Methylhistidine	83-1,008
β-Alanine	<= 17

Markers for Urine Representativeness

	Reference Range
Glutamine/Glutamate	>= 12
Ammonia	12.0-41.0 mmol/g creatinine
Arginine/Ornithine	>= 1.0

Urine Representativeness Index

Ref Range 5 – 10

Essential and Metabolic Fatty Acids Markers (RBCs)

Omega 3 Fatty Acids

Analyte	(cold water fish, flax, walnut)	Reference Range
α-Linolenic (ALA) 18:3 n3	0.12	>= 0.09 wt %
Eicosapentaenoic (EPA) 20:5 n3	1.06	>= 0.16 wt %
Docosapentaenoic (DPA) 22:5 n3	2.53	>= 1.14 wt %
Docosahexaenoic (DHA) 22:6 n3	5.6	>= 2.1 wt %
% Omega 3s	9.3	>= 3.8

Omega 9 Fatty Acids

Analyte	(olive oil)	Reference Range
Oleic 18:1 n9	13	10-13 wt %
Nervonic 24:1 n9	3.0	2.1-3.5 wt %
% Omega 9s	15.7	13.3-16.6

Saturated Fatty Acids

Analyte	(meat, dairy, coconuts, palm oils)	Reference Range
Palmitic C16:0	18	18-23 wt %
Stearic C18:0	17	14-17 wt %
Arachidic C20:0	0.25	0.22-0.35 wt %
Behenic C22:0	1.00	0.92-1.68 wt %
Tricosanoic C23:0	0.23	0.12-0.18 wt %
Lignoceric C24:0	2.7	2.1-3.8 wt %
Pentadecanoic C15:0	0.08	0.07-0.15 wt %
Margaric C17:0	0.29	0.22-0.37 wt %
% Saturated Fats	40.0	39.8-43.6

Omega 6 Fatty Acids

Analyte	(vegetable oil, grains, most meats, dairy)	Reference Range
Linoleic (LA) 18:2 n6	12.6	10.5-16.9 wt %
γ-Linolenic (GLA) 18:3 n6	0.07	0.03-0.13 wt %
Dihomo-γ-linolenic (DGLA) 20:3 n6	1.26	>= 1.19 wt %
Arachidonic (AA) 20:4 n6	18	15-21 wt %
Docosatetraenoic (DTA) 22:4 n6	2.06	1.50-4.20 wt %
Eicosadienoic 20:2 n6	0.22	<= 0.26 wt %
% Omega 6s	33.9	30.5-39.7

Monounsaturated Fats

Omega 7 Fats		Reference Range
Palmitoleic 16:1 n7	0.28	<= 0.64 wt %
Vaccenic 18:1 n7	0.73	<= 1.13 wt %
Trans Fat		
Elaidic 18:1 n9t	0.18	<= 0.59 wt %

Delta - 6 Desaturase Activity

	Upregulated Functional Impaired	
Linoleic / DGLA 18:2 n6 / 20:3 n6	10.1	6.0-12.3

Cardiovascular Risk

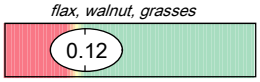
Analyte		Reference Range
Omega 6s / Omega 3s	3.6	3.4-10.7
AA / EPA 20:4 n6 / 20:5 n3	17	12-125
Omega 3 Index	6.6	>= 4.0

The Essential Fatty Acid reference ranges are based on an adult population.

Essential Fatty Acid Metabolism

Omega 3 Family

α-Linolenic Acid
flax, walnut, grasses



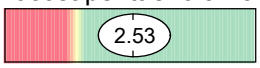
Stearidonic acid

Eicosatetraenoic acid, ETA

Eicosapentaenoic Acid
cold water fish

Anti-inflammatory Eicosanoids

Docosapentaenoic Acid



Docosahexaenoic Acid
cold water fish

Delta-6 Desaturase
Vitamin and Mineral Cofactors:
FAD (B2), Niacin (B3)
Pyridoxal-5-phosphate (B6)
Vitamin C, Insulin, Zn, Mg

Elongase
Vitamin and Mineral Cofactors:
Niacin (B3)
Pyridoxal-5-phosphate (B6)
Pantothenic Acid (B5)
Biotin, Vitamin C

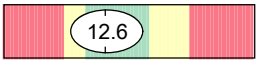
Delta-5 Desaturase
Vitamin and Mineral Cofactors:
FAD (B2), Niacin (B3)
Pyridoxal-5-phosphate (B6)
Vitamin C, Insulin, Zn, Mg

Elongase
Vitamin and Mineral Cofactors:
Niacin (B3)
Pyridoxal-5-phosphate (B6), Biotin
Pantothenic Acid (B5), Vitamin C

Elongase
Delta-6 Desaturase
Vitamin and Mineral Cofactors:
FAD (B2), Niacin (B3)
Pyridoxal-5-phosphate (B6), Biotin
Vitamin C, Zn, Mg, Carnitine
Pantothenic Acid (B5)

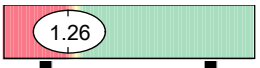
Omega 6 Family

Linoleic Acid
grains, vegetable oils



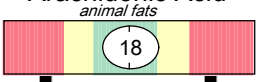
γ-Linolenic Acid
evening primrose, borage, black currant

Dihomo-γ-Linolenic Acid



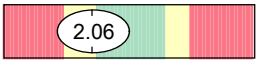
Series 1 Prostaglandins Anti-inflammatory

Arachidonic Acid
animal fats



Pro-inflammatory Eicosanoids

Docosatetraenoic Acid



This test was developed and its performance characteristics determined by Genova Diagnostics, Inc. It has not been cleared or approved by the U.S. Food and Drug Administration.

Oxidative Stress Markers

Oxidative Stress Markers

		Reference Range
Glutathione (whole blood)	664	>= 669 micromol/L
Lipid Peroxides (urine)	4.7	<=10.0 micromol/g Creat.
8-OHdG (urine)	6	<=16 mcg/g Creat.
Coenzyme Q10, Ubiquinone (plasma)	0.80	0.46-1.72 mcg/mL

The Oxidative Stress refence ranges are based on an adult population.

Vitamin D

	Inside Range	Outside Range	Reference Range
25 - OH Vitamin D ◆	67		50-100 ng/mL

Deficiency = < 20 ng/mL (< 50 nmol/L)
Insufficiency = 20-49 ng/mL (50-124 nmol/L)
Optimal = 50-100 ng/mL (125-250 nmol/L)
Excessive = > 100 ng/mL (> 250 nmol/L)

Elemental Markers (RBCs)

Nutrient Elements

Element	Reference Range	Reference Range
Copper	0.552	0.466-0.721 mcg/g
Magnesium	49.1	30.1-56.5 mcg/g
Manganese	0.012	0.007-0.038 mcg/g
Potassium	3,237	2,220-3,626 mcg/g
Selenium	0.34	0.25-0.76 mcg/g
Zinc	11.8	7.8-13.1 mcg/g

Toxic Elements

Element	Reference Range	Reference Range
Lead	0.042	<= 0.048 mcg/g
Mercury	<dl	<= 0.0039 mcg/g
Antimony	0.001	<= 0.002 mcg/g
Arsenic	0.014	<= 0.071 mcg/g
Cadmium	0.000	<= 0.001 mcg/g
Tin	<dl	<= 0.0009 mcg/g

The Elemental refence ranges are based on an adult population.

Lab Comments

Lab Comments
FMV Urines, Amber Plasma, and Serum samples not received; holding until panel complete. 04/14/2012 cs7
Resubmittal: E8140110, received Amber vial plasma, Serum, and FMV urines to complete testing. 04/18/2012 TD

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.

Commentary

2,3 Dihydroxyphenylpropionic acid (DHPPA) is elevated. This organic acid is a byproduct of the bacterial metabolism of phenylalanine, tyrosine, and/or tryptophan. Research has identified various species of Clostridia in the *in-vitro* production of this compound. Other research on quinoline demonstrates production of DHPPA by Pseudomonas species. Presence of elevated levels of DHPPA in the urine may thus suggest overgrowth of Clostridia and/or Pseudomonas, as well as a degree of malabsorption of aromatic amino acids. A comprehensive stool analysis is suggested.

Homovanillic Acid (HVA, or 3-methoxy-4-hydroxyphenylacetic acid) is elevated. HVA is a normal metabolite of dopamine via methylation (requires SAM and a magnesium-activated enzyme), and deamination (requires vitamin B6), and oxidation by monoamine oxidase (MAO) (which uses vitamin B2 as FAD). Infants and male children typically have higher urine HVA than do older children and females. Excessive urine HVA can occur with mental disturbances and with dopaminergic dysfunction. HVA is elevated in urine when the metabolism of dopamine is impaired or dopamine turnover is increased (as may occur with administration of choline or physostigmine).

Dopamine becomes norepinephrine using the enzyme dopamine beta-hydroxylase. This enzyme requires copper for its activation, and oxygen and ascorbic acid as cofactors. Insufficient copper or ascorbate may result in elevated urine HVA, as may other impairments in adrenal catecholamine metabolism. If elevated HVA is due to impaired dopamine-to-norepinephrine metabolism, then epinephrine formation can be slowed or erratic. Individuals with this problem may also present fatigue if the required epinephrine stimulus for glycogenolysis is deficient.

Lactic Acid , or lactate, is measured to be low. Lactate is formed from pyruvate in anaerobic or oxygen starved (hypoxic) circumstances to allow for ongoing production of ATP in these anaerobic conditions. There are no known clinical problems associated with low lactic acid. Low levels are usually a result of reduced amounts of its precursor, pyruvic acid.

Homogentisic Acid is elevated in the urine. Homogentisic acid follows 4-hydroxyphenylpyruvic acid (4-HPPA) in tyrosine metabolism. Homogentisic acid is then oxidized to 4-malylacetoacetic acid via an enzyme that is activated by iron and assisted by ascorbic acid. The enzyme carries and requires active sulfhydryl groups (-SH), which can be protected by reduced glutathione.

Slight or mild elevations of homogentisic acid may have no attendant symptoms. Vitamin C and reducing nutrients, particularly N-acetylcysteine and glutathione, may aid mild or moderately elevated homogentisic acid. At the same time, adequate tissue oxygenation is required for activity of the dioxygenase enzyme. Improved tissue oxygenation may require the correction of any anemia or pulmonary problems, or be improved by the use of oxygen-enhancing nutrients such as para-aminobenzoic acid (PABA) and ginkgo biloba.

Hereditary deficiency of the dioxygenase leads to alcaptonuria, (urinary excess of homogentisic acid). This is a rare condition, and was the first metabolic disorder to be described in medical science (Boedecker, 1859; Garrod, 1909). The disease features a bluish-black discoloration of connective tissue and arthritis that develops in adulthood. Lifespan and mental capacity are not affected; however, renal stones, prostatitis, ruptured intervertebral discs and cardiovascular implications are frequent.

Commentary

Commentary is provided to the practitioner for educational purposes, and should not be interpreted as diagnostic or treatment recommendations. Diagnosis and treatment decisions are the responsibility of the practitioner.

REPRESENTATIVENESS INDEX

Urine amino acid levels usually are representative of blood levels and reflect dietary uptake and metabolism as well as excretion. However, abnormal renal clearance, loss of urine during the collection period, decay or spoilage, and presence of blood in the urine could cause the urine specimen to be unrepresentative. The possibility of such problems can be judged from analytical measurements which are portrayed in the first section of the report: Markers for Urine Representativeness.

The **glutamine/glutamate ratio** can indicate specimen decay. When aged or improperly preserved, urine glutamine decays to glutamic acid and ammonia. However, in metabolic acidosis some glutamine is transformed into glutamic acid and ammonium ion as a pH-balancing mechanism. Also, high glutamic acid occurs in gout. Hence, low glutamine/glutamate ratio may reflect decay or it may be of metabolic origin. High glutamine/glutamate ratio is metabolic and does not reflect on specimen representativeness.

The **ammonia concentration**, if elevated, usually indicates overall decay of amino acids. An exception would be elevated ammonia concentration with hyperammonemia of metabolic or bacterial origin. Very low ammonia concentration suggests low urine nitrogen levels and may occur in protein-deficient diets. Blood amino acid levels may then be normal or low-normal.

The **arginine/ornithine ratio** generally reflects whether the sample is purely urine or whether hematuria is present. A low ratio is consistent with blood in the urine. This is not foolproof, because high ornithine relative to arginine also may occur with a specific urea cycle weakness (OCT enzyme dysfunction, rare), and with pyridoxal phosphate or transamination weakness affecting ornithine. Urine should not be collected for acid analysis by women during menses. Blood in urine can notably distort the results.

The computer scores the above four Markers for Representativeness and computes a Representativeness Index. An index of 10 means all markers are within expected limits. **An index below 5 suggests a repeat amino acid analysis with a new urine specimen.**

1-Methylhistidine is found to be elevated; it is a component of the dietary peptide anserine. Anserine is beta-alanyl-1-methyl-L-histidine, and it is known to come from chicken, turkey, duck, rabbit, tuna and salmon. Other food sources (especially trout and fowl) also are likely but are not documented. The peptidase enzyme that hydrolyzes anserine is present in the small intestine and also present in liver, spleen, and kidney tissues and in blood serum. Some direct uptake of dietary anserine is normal, and moderate levels of urinary 1-methylhistidine are normal. However, high levels suggest increased uptake of short-chain peptides, possibly increased gut permeability, and increased hydrolysis of short-chain dietary peptides by peptidases in blood, liver and spleen. Elevated 1-methylhistidine suggests one or more of: dietary overload of anserine-source foods, increased gut permeability, and decreased activity of digestive peptidases in the small intestine. There may or may not be associated symptomatology. 1-Methylhistidine itself is not known to be detrimental.

Cystathionine is an intermediary metabolite of the essential amino acid methionine, and cystathionine is subnormal per the urine analysis. Cystathionine is preceded by homocysteine, and it leads to cysteine and alpha-ketobutyric acid. Cystathionine formation from homocysteine requires the amino acid serine and vitamin B6 as coenzyme pyridoxal 5-phosphate (P 5-P). Low cystathionine with normal (or high) methionine and normal homocystine may indicate limited serine but usually indicates increased need for vitamin B6 or pyridoxal phosphate.

Depending upon need for and levels of cysteine, cystine and taurine, this problem may or may not have associated symptoms and may only be a transient physiological imbalance. However, if low cystathionine reflects a significant weakness in the activity of its formation enzyme (cystathionine beta-synthase), then clinical abnormalities could be associated with this finding. Pathologies associated with impaired cystathionine beta-synthase include: ectopia lentis, myopia, osteoporosis, scoliosis, CNS disorders, and arterial and venous thromboemboli.

Commentary

Glutamic acid is measured to be elevated in urine. Dicarboxylic hyperaminoaciduria is not present. The known conditions consistent with isolated glutamic aciduria are as follows.

(1) Ingestion of excessive levels of monosodium glutamate "MSG"
(2) Ingestion of nutritional supplements containing large amounts of glutamic acid
(3) Gout or pregout, check blood/urine uric acid levels
(4) Some imbalance or impairment in purine metabolism
(5) Metabolic or renal acidosis

Conditions (1) and (2) are expected to normalize soon after the dietary source is discontinued. Conditions (3) and (4) are often best corrected by a low purine diet. Purine metabolism disorders are uncommon and differential diagnosis is difficult. In metabolic or renal acidosis, glutaminase in the kidneys forms glutamic acid and ammonia which becomes basic ammonium hydroxide. This is a normal pH balancing mechanism for compensating acidosis. Acidoses can feature increased serum anion gap (ketoacidoses of diabetes or alcoholism or lactic acidoses of respiratory insufficiency, chemical toxicity, circulatory problems, etc.) or may be hyperchloremic with normal anion gap (renal tubular acidosis, hypoaldosteronism, alkali-loss diarrhea).

Essential & Metabolic Fatty Acids Markers (RBCs)

Commentary

Fatty Acids and Your Health

Doctors and nutritionists used to think that all fat was merely a way for the body to store calories for later use as energy, since, as we all know too well, if we eat excess food, our body converts those calories to fat. Only in the last century have we discovered that some fats are absolutely essential to health. Our bodies cannot make these fats, and so we must get them from our food, or our health will suffer. These Essential Fatty Acids (EFAs) have many functions in the body: they are the precursors for local "hormones"; they regulate all inflammation as well as all smooth muscle contraction and relaxation. These local hormones are given names like prostaglandins, leukotrienes and thromboxanes. EFAs are also essential components for all cell membranes. Their importance for health cannot be overemphasized since the brain, nerves, eyes, connective tissue, skin, blood vessels, and every cell in the body depend on a proper balance of essential fatty acids for optimal function. It is the fats found in red blood cell membranes, known as phospholipids, that this test measures.

Essential fatty acids are classified into fat "families": omega 3 fats and omega 6 fats. Non-essential fat "families" include omega-9 fats, saturated fats, omega-7 fats, and trans-fats. Optimal health depends on the proper balance of all fats - both essential and non-essential fats - in the diet. Proper balance means adequate amounts of each individual fat, without having too much, and maintaining proper balance between the various "families" of fats. Fat health also means avoiding potentially harmful fats such as trans fats found in shortening, margarine, fried foods and dairy. A proper balance of fatty acids will lead to mental health and proper nerve function, a healthy heart and circulatory system, reduced inflammation in general, proper gastrointestinal and lung function, a more balanced immune system, and even healthy skin, hair and nails. Fatty acid balance is also critical for the health of all pregnant women and their babies since the developing brain and nervous system of the baby requires large amounts of EFAs that must come from the mother. Fatty acid imbalances have been seen in many disease processes including heart disease, hypertension, insulin resistance and diabetes, asthma, painful menstruation, pre-menstrual syndrome (PMS), depression, attention deficit hyperactivity disorder (ADHD), senility, obsessive-compulsive disorder, and post-partum depression.

This Essential and Metabolic Fatty Acid Analysis allows your health care practitioner to examine the fats found in your red blood cell membranes. These fats represent the types of fats your body has available to make cell membranes and the local "hormones" that control inflammation and smooth muscle contraction throughout the body. Following your health care practitioner's advice on diet and fatty acid supplementation is likely to restore your fatty acids to a state of healthy balance.

Results of Your Individual Essential and Metabolic Fatty Acid Analysis

Dihomo Gamma Linolenic Acid (DGLA) is within the reference range, but below the functional physiologic range. DGLA is the main precursor fat for the production of highly anti-inflammatory eicosanoids, especially the series 1 prostaglandins. Low DGLA is often associated with inflammatory conditions such as heart disease, arthritis, inflammatory bowel disorders, eczema, and psoriasis. Since DGLA-derived eicosanoids also promote smooth muscle relaxation, low DGLA levels may contribute to increased smooth muscle contraction, and subsequently to conditions like hypertension, asthma, painful menstruation, and irritable bowel syndrome.

Low DGLA can result from impaired conversion of linoleic acid into gamma-linolenic acid (and subsequently into DGLA) or from an increased conversion of DGLA into arachidonic acid or both. Delta-6 desaturase is the enzyme responsible for converting LA into GLA and may be impaired with age, alcohol use, genetic defect, or nutrient deficiency. An elevated linoleic/DGLA ratio or an elevated eicosadienoic/DGLA ratio (see p.3 of this report) would strongly suggest impaired delta-6 desaturase activity. Supplementation with GLA-containing oils like evening

Commentary

primrose, borage or black currant seed oils bypasses delta-6 desaturase.

A low DGLA/arachidonic acid ratio (see p.3 of this report) would indicate a likely increased activity of delta-5 desaturase. Insulin activates delta-5 desaturase. A high carbohydrate (sugars and starch) diet increases insulin secretion and action in the body. Consumption of a higher protein and higher fiber and complex carbohydrate diet reduces insulin action in the body. Eicosapentaenoic acid (EPA) supplementation, found in fish and fish oils, has also been shown to reduce delta-5 desaturase activity, reducing the conversion of DGLA into AA.

Oleic acid is within the reference range, but above the functional physiologic range. Oleic acid is important in maintaining cell membrane fluidity. High oleic acid may result from the consumption of olive oil, high-oleic safflower, or high-oleic sunflower oil. Moderately high levels may be indicative of increased olive oil consumption and are likely to be of no clinical concern.

Pentadecanoic acid and/or Tricosanoic acid are above the reference range. Odd chain fatty acids are produced when endogenous fatty acid synthesis begins with propionic acid (3-carbon fatty acid) as substrate rather than acetic acid (2-carbon). Propionate is found in high quantities in butter and other dairy products. Propionate is also one of the short chain fatty acids produced by our gut bacteria in the fermentation (digestion) of water-soluble fiber. With adequate B12 and biotin, propionate can be converted into succinate for use in the citric acid cycle and energy production. High levels of odd chain fatty acids in cell membranes may indicate an increased need for B12 and biotin, or may result from an exceptionally high water-soluble fiber diet.

Oxidative Stress Markers

Commentary

Commentary is provided to the practitioner for educational purposes, and should not be interpreted as diagnostic or treatment recommendations. Diagnosis and treatment decisions are the responsibility of the practitioner.

Glutathione is a major antioxidant, anticarcinogen and marker of antioxidant status of the body. Glutathione is used by the body to prevent or minimize damage by oxidative free radicals. A low level indicates reduced ability of the body to remove free radicals and shows increased oxidative stress. Frequently, low levels of glutathione are associated with endo- and exotoxicity, autoimmune diseases and chronic inflammation

The performance characteristics of this assay have been verified by Genova Diagnostics, Inc. This assay for Vitamin D has been cleared by the U.S. Food and Drug Administration.

Optimal levels:

Vitamin D is a hormone produced in the skin during expose to sunlight or consumed in the diet, and converted to its active form, calcitriol, in the liver and kidneys. Vitamin D helps regulate serum calcium and phosphorus levels by increasing intestinal absorption of calcium and stimulating tubular reabsorption of calcium. Vitamin D also affects numerous other functions in the body.

Optimal levels are protective against osteoporosis as well as infection, autoimmune disease, hypertension, arteriosclerosis, diabetes and insulin resistance, musculoskeletal pain, epilepsy, and migraine.

Elemental Markers (RBCs)

Commentary

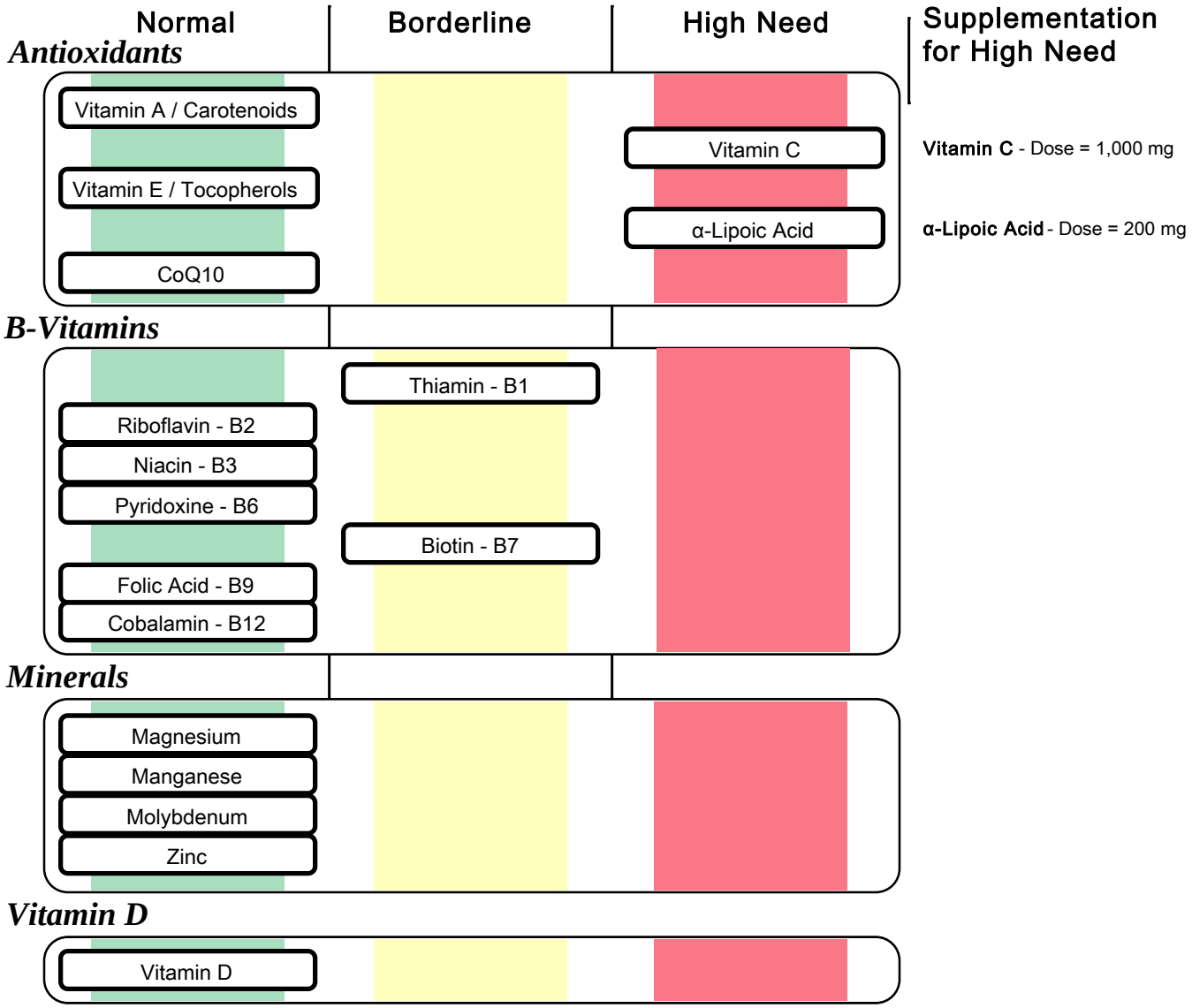
All of the measured erythrocyte elements are within the laboratory reference range.

Genova Diagnostics®

Parkgate House
356 West Barnes Lane

63 Zillicoa Street
Asheville, NC 28801 USA

NutrEval Results Overview



Supplements	Daily Recommended Intake (DRI)	Patient's Daily Recommendations	Provider Daily Recommendations
Antioxidants			
Vitamin A / Carotenoids	3,000 IU	3,000 IU	
Vitamin C	90 mg	1,000 mg	
Vitamin E / Tocopherols	22 IU	100 IU	
α-Lipoic Acid		200 mg	
CoQ10		30 mg	
B-Vitamins			
Thiamin - B1	1.2 mg	25 mg	
Riboflavin - B2	1.3 mg	10 mg	
Niacin - B3	16 mg	20 mg	
Pyridoxine - B6	1.3 mg	10 mg	
Biotin - B7	30 mcg	200 mcg	
Folic Acid - B9	400 mcg	400 mcg	
Cobalamin - B12	2.4 mcg	100 mcg	
Minerals			
Magnesium	420 mg	400 mg	
Manganese	2.3 mg	3.0 mg	
Molybdenum	45 mcg	75 mcg	
Zinc	11 mg	10 mg	
Essential Fatty Acids			
Omega-3 Oils	500 mg	500 mg	
Digestive Support			
Probiotics		25 billion CFU	
Pancreatic Enzymes		5,000 IU	
Other Vitamins			
Vitamin D	600 IU	1,000 IU	

Amino Acid	mg/day	Amino Acid	mg/day
Arginine	0	Methionine	0
Asparagine	41	Phenylalanine	0
Cysteine	0	Serine	0
Glutamine	742	Taurine	0
Glycine	1,349	Threonine	0
Histidine	189	Tryptophan	0
Isoleucine	0	Tyrosine	292
Leucine	0	Valine	225
Lysine	1,122		

Recommendations for age and gender-specific supplementation are set by comparing levels of nutrient functional need to optimal levels as described in the peer-reviewed literature. They are provided as guidance for short-term support of nutritional deficiencies only.

The Suggested Supplemental Schedule is provided at the request of the ordering practitioner. Any application of it as a therapeutic intervention is to be determined by the ordering practitioner.

Key Normal · Borderline · High Need

NutrEval FMV amino acids — Interpretation At-A-Glance

Nutritional Needs

Antioxidants

Vitamin A / Carotenoids

- 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.

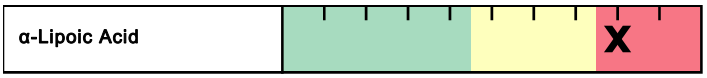
Vitamin C

- 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.

Vitamin E / Tocopherols

- 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.

α-Lipoic Acid



- α-Lipoic acid plays an important role in energy production, antioxidant activity (including the regeneration of vitamin C and glutathione), insulin signaling, cell signaling and the catabolism of α-keto acids and amino acids.
- High biotin intake can compete with lipoic acid for cell membrane entry.
- Optimal levels of α-lipoic acid may improve glucose utilization and protect against diabetic neuropathy, vascular disease and age-related cognitive decline.
- Main food sources include organ meats, spinach and broccoli. Lesser sources include tomato, peas, Brussels sprouts and brewer's yeast.

CoQ10

- CoQ10 is a powerful antioxidant that is synthesized in the body and contained in cell membranes. CoQ10 is also essential for energy production & pH regulation.
- CoQ10 deficiency may occur with HMG-CoA reductase inhibitors (statins), several anti-diabetic medication classes (biguanides, sulfonylureas) or beta-blockers.
- Low levels may aggravate oxidative stress, diabetes, cancer, congestive heart failure, cardiac arrhythmias, gingivitis and neurologic diseases.
- Main food sources include meat, poultry, fish, soybean, canola oil, nuts and whole grains. Moderate sources include fruits, vegetables, eggs and dairy.

Glutathione

- Glutathione (GSH) is composed of cysteine, glutamine & glycine. GSH is a source of sulfate and plays a key role in antioxidant activity and detoxification of toxins.
- GSH requirement is increased with high-fat diets, cigarette smoke, cystinuria, chronic alcoholism, chronic acetaminophen use, infection, inflammation and toxic exposure.
- Deficiency may result in oxidative stress & damage, impaired detoxification, altered immunity, macular degeneration and increased risk of chronic illness.
- Food sources of GSH precursors include meats, poultry, fish, soy, corn, nuts, seeds, wheat germ, milk and cheese.

Plant-based Antioxidants

- Oxidative stress is the imbalance between the production of free radicals and the body's ability to readily detoxify these reactive species and/or repair the resulting damage with anti-oxidants.
- Oxidative stress can be endogenous (energy production and inflammation) or exogenous (exercise, exposure to environmental toxins).
- Oxidative stress has been implicated clinically in the development of neurodegenerative diseases, cardiovascular diseases and chronic fatigue syndrome.
- Antioxidants may be found in whole food sources (e.g., brightly colored fruits & vegetables, green tea, turmeric) as well as nutriceuticals (e.g., resveratrol, EGCG, lutein, lycopene, ginkgo, milk thistle, etc.).

Key

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

NutrEval FMV amino acids

Interpretation At-A-Glance

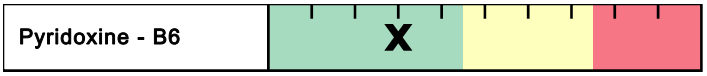
Nutritional Needs

B-Vitamins

Thiamin - B1

- 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.

Pyridoxine - B6



- 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.

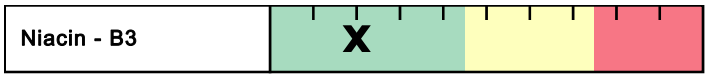
Riboflavin - B2

- 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.

Biotin - B7

- Biotin is a cofactor for enzymes involved in functions such as fatty acid 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, 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.

Niacin - B3

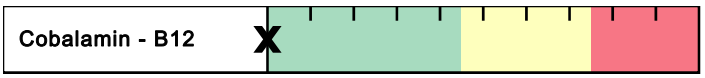


- B3 is used to form NAD and NADP, involved in energy production from food, fatty acid & cholesterol synthesis, cell signaling, DNA repair & cell differentiation.
- Low B3 may result from deficiencies of tryptophan (B3 precursor), B6, B2 or Fe (cofactors in B3 production), or from long-term isoniazid 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.

Folic Acid - B9

- 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.

Cobalamin - B12

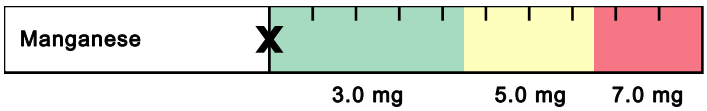


- B12 plays important roles in energy production from fats & proteins, methylation, synthesis of hemoglobin & RBCs, and maintenance of nerve cells, DNA & RNA.
- Low B12 may result from alcoholism, malabsorption, hypochlorhydria (e.g., from atrophic gastritis, H. pylori infection, pernicious anemia, H2 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.

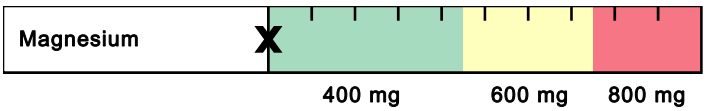
NutrEval FMV amino acids — Interpretation At-A-Glance

Nutritional Needs

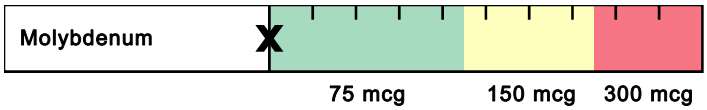
Minerals



- 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.



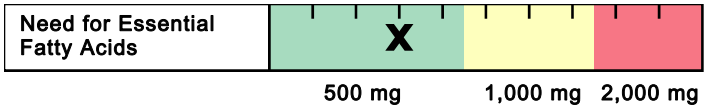
- Magnesium is involved in >300 metabolic reactions. Key areas include energy production, bone & ATP formation, muscle & nerve conduction and cell signaling.
- Deficiency may occur with malabsorption, alcoholism, hyperparathyroidism, renal disorders (wasting), diabetes, diuretics, digoxin or high doses 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.



- 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).

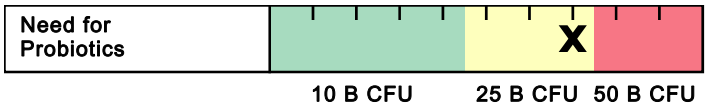
- Zinc plays a vital role in immunity, protein metabolism, heme synthesis, growth & development, reproduction, digestion and antioxidant function.
- Low levels may occur with malabsorption, alcoholism, chronic diarrhea, diabetes, excess Cu or Fe, diuretics, ACE inhibitors, H2 blockers or digoxin.
- Deficiency 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.

Essential Fatty Acids

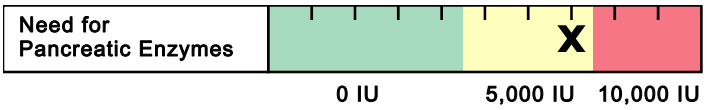


- Omega-3 (O3) and Omega-6 (O6) fatty acids are polyunsaturated fatty acids that cannot be synthesized by the human body. They are classified as essential nutrients and must be obtained from dietary sources.
- The standard American diet is much higher in O6 than O3 fatty acids. Deficiency of EFAs may result from poor dietary intake and/or poor conversion from food sources.
- EFA deficiency is associated with decreased growth & development of infants and children, dry skin/rash, poor wound healing, and increased risk of infection, cardiovascular and inflammatory diseases.
- Dietary sources of the O6 Linoleic Acid (LA) include vegetable oils, nuts, seeds and some vegetables. Dietary sources of the O3 a-Linolenic Acid (ALA) include flaxseeds, walnuts, and their oils. Fish (mackerel, salmon, sardines) are the major dietary sources of the O3 fatty acids EPA and DHA.

Digestive Support

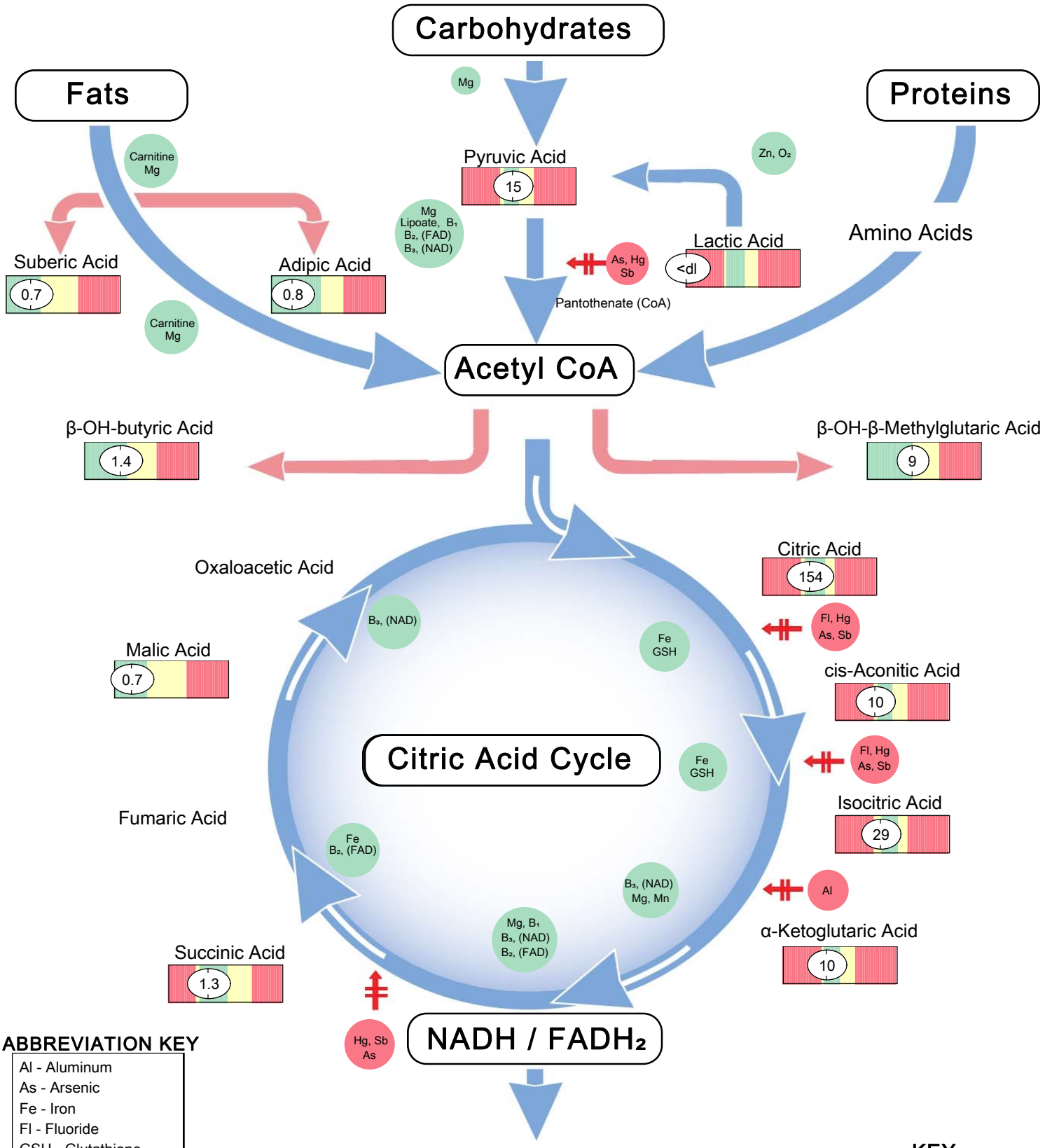


- Probiotics have many functions. These include: production of some B vitamins and vitamin K; enhance digestion & absorption; decrease severity of diarrheal illness; modulate of immune function & intestinal permeability.
- Alterations of gastrointestinal microflora may result from C-section delivery, 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.



- 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.

Krebs Cycle At-A-Glance



ABBREVIATION KEY

Al - Aluminum
As - Arsenic
Fe - Iron
Fl - Fluoride
GSH - Glutathione
Hg - Mercury
Mg - Magnesium
Mn - Manganese
Sb - Antimony
Zn - Zinc

Electron Transport and Oxidative Phosphorylation

$(2)\ H + 1/2\ O_2 \rightarrow H_2O$

KEY

Green = cofactor

Red = inhibitor

Metabolic Analysis Markers

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

Malabsorption and Dysbiosis Markers

Malabsorption Markers

		Reference Range
Indoleacetic Acid (IAA)	0.8	<= 4.2
Phenylacetic Acid (PAA)	0.08	<= 0.12

Bacterial Dysbiosis Markers

		Reference Range
Dihydroxyphenylpropionic Acid (DHPPA)	13.2	<= 5.3
3-Hydroxyphenylacetic Acid	3.1	<= 8.1
4-Hydroxyphenylacetic Acid	24	<= 29
Benzoic Acid	0.05	<= 0.05
Hippuric Acid	352	<= 603

Yeast / Fungal Dysbiosis Markers

		Reference Range
Arabinose	74	<= 96
Citramalic Acid	2.6	<= 5.8
Tartaric Acid	<dl	<= 15

Cellular Energy & Mitochondrial Metabolites

Carbohydrate Metabolism

		Reference Range
Lactic Acid	<dl	1.9-19.8
Pyruvic Acid	15	7-32
β-OH-Butyric Acid (BHBA)	1.4	<= 2.8

Energy Metabolism

		Reference Range
Citric Acid	154	40-520
Cis-Aconitic Acid	10	10-36
Isocitric Acid	29	22-65
α-Ketoglutaric Acid (AKG)	10	4-52
Succinic Acid	1.3	0.4-4.6
Malic Acid	0.7	<= 3.0
β-OH-β-Methylglutaric Acid (HMG)	9	<= 15

Fatty Acid Metabolism

		Reference Range
Adipic Acid	0.8	<= 2.8
Suberic Acid	0.7	<= 2.1

Creatinine Concentration

		Reference Range
Creatinine ◆	10.8	3.1-19.5 mmol/L

Neurotransmitter Metabolites

		Reference Range
Vanilmandelic Acid	0.9	0.4-3.6
Homovanilic Acid	5.5	1.2-5.3
5-OH-indoleacetic Acid	8.2	3.8-12.1
3-Methyl-4-OH-phenylglycol	0.06	0.02-0.22
Kynurenic Acid	2.0	<= 7.1
Quinolinic Acid	4.2	<= 9.1
Kynurenic / Quinolinic Ratio	0.48	>= 0.44

Vitamin Markers

		Reference Range
α-Ketoadipic Acid	0.4	<= 1.7
α-Ketoisovaleric Acid	0.53	<= 0.97
α-Ketoisocaproic Acid	0.43	<= 0.89
α-Keto-β-Methylvaleric Acid	1.1	<= 2.1
Formiminoglutamic Acid (FIGlu)	0.4	<= 1.5
Glutaric Acid	0.24	<= 0.51
Isovalerylglycine	1.1	<= 3.7
Methylmalonic Acid	1.1	<= 1.9
Xanthurenic Acid	0.66	<= 0.96
3-Hydroxypropionic Acid	7	5-22
3-Hydroxyisovaleric Acid	17	<= 29

Toxin & Detoxification Markers

		Reference Range
α-Ketophenylacetic Acid (from Styrene)	0.22	<= 0.46
α-Hydroxyisobutyric Acid (from MTBE)	5.0	<= 6.7
Orotic Acid	0.48	0.33-1.01
Pyroglutamic Acid	22	16-34

Tyrosine Metabolism

		Reference Range
Homogentisic Acid	32	<= 19
2-Hydroxyphenylacetic Acid	0.60	<= 0.76

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.

Amino Acids (FMV)

All biomarkers reported in micromol/gm creatinine unless otherwise noted.

Nutritionally Essential Amino Acids

Amino Acid		Reference Range
Arginine	19	10-64
Histidine	356	271-993
Isoleucine	26	17-52
Leucine	53	25-77
Lysine	38	34-226
Methionine	46	26-69
Phenylalanine	35	22-61
Taurine	293	80-545
Threonine	84	52-192
Tryptophan	36	23-88
Valine	21	19-53

Nonessential Protein Amino Acids

Amino Acid		Reference Range
Alanine	114	103-392
Asparagine	51	37-134
Aspartic Acid	31	27-74
Cysteine	52	19-70
Cystine	24	23-68
γ-Aminobutyric Acid	8	<= 23
Glutamic Acid	17	3-15
Glutamine	166	153-483
Proline	4	2-14
Tyrosine	34	28-113

Creatinine Concentration

		Reference Range
Creatinine ◆	10.7	3.1-19.5 mmol/L

Amino Acid 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.

Intermediary Metabolites

B Vitamin Markers		Reference Range
α-Aminoadipic Acid	30	11-73
α-Amino-N-butyric Acid	13	9-49
β-Aminoisobutyric Acid	149	19-163
Cystathionine	5	6-29
3-Methylhistidine	295	134-302

Urea Cycle Markers		
Ammonia	35.5	12.0-41.0 mmol/g creatinine
Citrulline	21	9-40
Ornithine	7	3-16
Urea ◆	323	150-380 mmol/g creatinine

Glycine/Serine Metabolites		
Glycine	486	434-1,688
Serine	225	135-426
Ethanolamine	195	156-422
Phosphoethanolamine	34	14-50
Phosphoserine	33	26-64
Sarcosine	27	<= 41

Dietary Peptide Related Markers

		Reference Range
Anserine (dipeptide)	59	8-118
Carnosine (dipeptide)	35	12-120
1-Methylhistidine	1,915	83-1,008
β-Alanine	12	<= 17

Markers for Urine Representativeness

		Reference Range
Glutamine/Glutamate	10	>= 12
Ammonia	35.5	12.0-41.0 mmol/g creatinine
Arginine/Ornithine	2.7	>= 1.0

Urine Representativeness Index	9	Ref Range 5 – 10

Essential and Metabolic Fatty Acids Markers (RBCs)

Omega 3 Fatty Acids

Analyte	(cold water fish, flax, walnut)	Reference Range
α-Linolenic (ALA) 18:3 n3	0.12	>= 0.09 wt %
Eicosapentaenoic (EPA) 20:5 n3	1.06	>= 0.16 wt %
Docosapentaenoic (DPA) 22:5 n3	2.53	>= 1.14 wt %
Docosahexaenoic (DHA) 22:6 n3	5.6	>= 2.1 wt %
% Omega 3s	9.3	>= 3.8

Omega 9 Fatty Acids

Analyte	(olive oil)	Reference Range
Oleic 18:1 n9	13	10-13 wt %
Nervonic 24:1 n9	3.0	2.1-3.5 wt %
% Omega 9s	15.7	13.3-16.6

Saturated Fatty Acids

Analyte	(meat, dairy, coconuts, palm oils)	Reference Range
Palmitic C16:0	18	18-23 wt %
Stearic C18:0	17	14-17 wt %
Arachidic C20:0	0.25	0.22-0.35 wt %
Behenic C22:0	1.00	0.92-1.68 wt %
Tricosanoic C23:0	0.23	0.12-0.18 wt %
Lignoceric C24:0	2.7	2.1-3.8 wt %
Pentadecanoic C15:0	0.08	0.07-0.15 wt %
Margaric C17:0	0.29	0.22-0.37 wt %
% Saturated Fats	40.0	39.8-43.6

Omega 6 Fatty Acids

Analyte	(vegetable oil, grains, most meats, dairy)	Reference Range
Linoleic (LA) 18:2 n6	12.6	10.5-16.9 wt %
γ-Linolenic (GLA) 18:3 n6	0.07	0.03-0.13 wt %
Dihomo-γ-linolenic (DGLA) 20:3 n6	1.26	>= 1.19 wt %
Arachidonic (AA) 20:4 n6	18	15-21 wt %
Docosatetraenoic (DTA) 22:4 n6	2.06	1.50-4.20 wt %
Eicosadienoic 20:2 n6	0.22	<= 0.26 wt %
% Omega 6s	33.9	30.5-39.7

Monounsaturated Fats

Omega 7 Fats		Reference Range
Palmitoleic 16:1 n7	0.28	<= 0.64 wt %
Vaccenic 18:1 n7	0.73	<= 1.13 wt %
Trans Fat		
Elaidic 18:1 n9t	0.18	<= 0.59 wt %

Delta - 6 Desaturase Activity

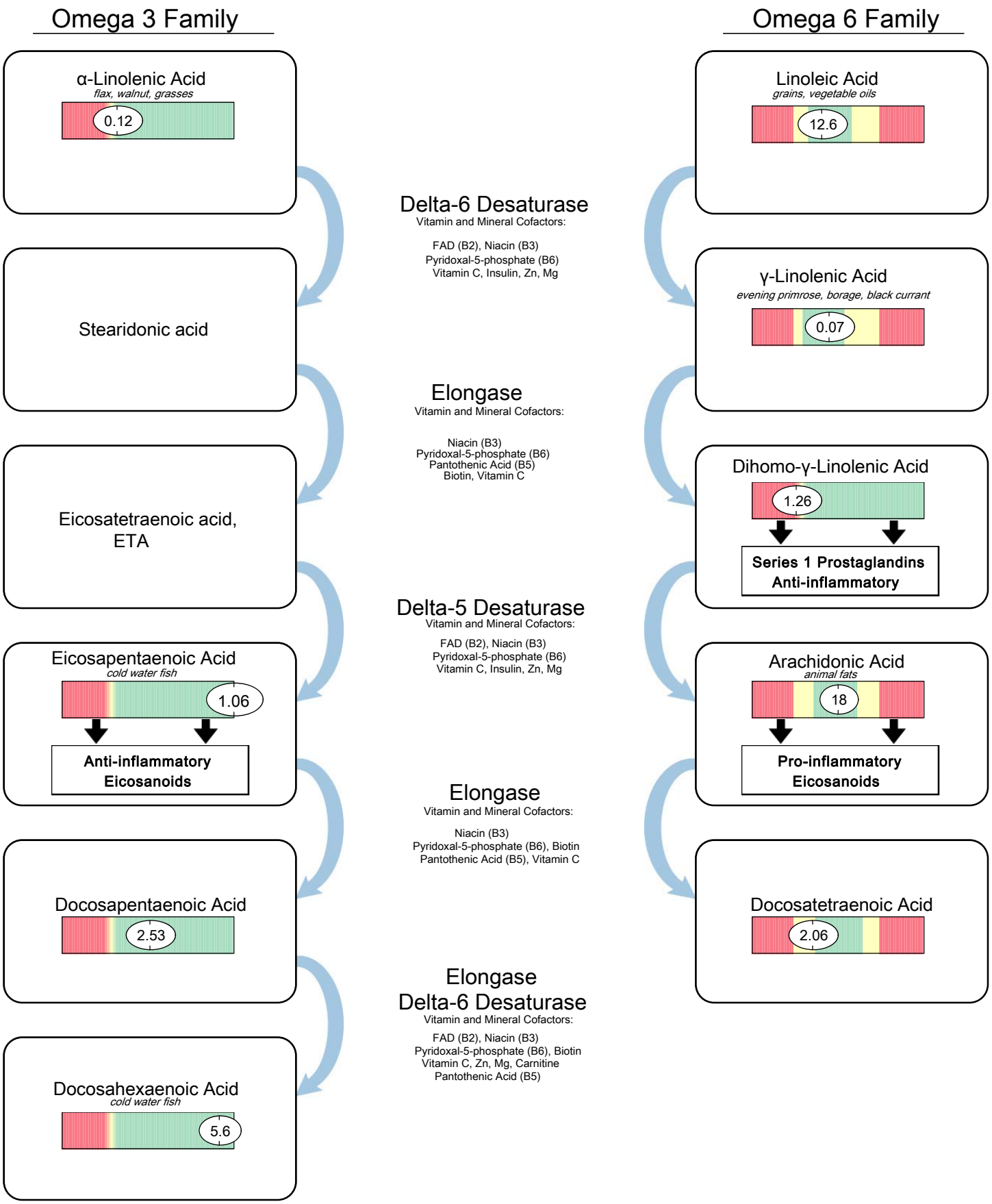
	Upregulated Functional Impaired	
Linoleic / DGLA 18:2 n6 / 20:3 n6	10.1	6.0-12.3

Cardiovascular Risk

Analyte		Reference Range
Omega 6s / Omega 3s	3.6	3.4-10.7
AA / EPA 20:4 n6 / 20:5 n3	17	12-125
Omega 3 Index	6.6	>= 4.0

The Essential Fatty Acid reference ranges are based on an adult population.

Essential Fatty Acid Metabolism



This test was developed and its performance characteristics determined by Genova Diagnostics, Inc. It has not been cleared or approved by the U.S. Food and Drug Administration.

Oxidative Stress Markers

Oxidative Stress Markers

		Reference Range
Glutathione (whole blood)	664	>= 669 micromol/L
Lipid Peroxides (urine)	4.7	<=10.0 micromol/g Creat.
8-OHdG (urine)	6	<=16 mcg/g Creat.
Coenzyme Q10, Ubiquinone (plasma)	0.80	0.46-1.72 mcg/mL

The Oxidative Stress refence ranges are based on an adult population.

Vitamin D

	Inside Range	Outside Range	Reference Range
25 - OH Vitamin D ◆	67		50-100 ng/mL

Deficiency = < 20 ng/mL (< 50 nmol/L)
Insufficiency = 20-49 ng/mL (50-124 nmol/L)
Optimal = 50-100 ng/mL (125-250 nmol/L)
Excessive = > 100 ng/mL (> 250 nmol/L)

Elemental Markers (RBCs)

Nutrient Elements

Element	Reference Range	Reference Range
Copper	0.552	0.466-0.721 mcg/g
Magnesium	49.1	30.1-56.5 mcg/g
Manganese	0.012	0.007-0.038 mcg/g
Potassium	3,237	2,220-3,626 mcg/g
Selenium	0.34	0.25-0.76 mcg/g
Zinc	11.8	7.8-13.1 mcg/g

Toxic Elements

Element	Reference Range	Reference Range
Lead	0.042	<= 0.048 mcg/g
Mercury	<dl	<= 0.0039 mcg/g
Antimony	0.001	<= 0.002 mcg/g
Arsenic	0.014	<= 0.071 mcg/g
Cadmium	0.000	<= 0.001 mcg/g
Tin	<dl	<= 0.0009 mcg/g

The Elemental refence ranges are based on an adult population.

Lab Comments

Lab Comments
FMV Urines, Amber Plasma, and Serum samples not received; holding until panel complete. 04/14/2012 cs7
Resubmittal: E8140110, received Amber vial plasma, Serum, and FMV urines to complete testing. 04/18/2012 TD

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.

Homocysteine (plasma)

Parkgate House
356 West Barnes Lane
New Malden, Surrey KT3 6NB

63 Zillicoa Street
Asheville, NC 28801 USA

Blood Tests

		Reference Range
Homocysteine (plasma)	8.19	5.20-11.40 micromol/L
Coenzyme Q10, Ubiquinone (plasma)	0.80	0.46-1.72 mcg/mL

Commentary

Lab Comments
FMV Urines, Amber Plasma, and Serum samples not received; holding until panel complete. 04/14/2012 cs7
Resubmittal: E8140110, received Amber vial plasma, Serum, and FMV urines to complete testing. 04/18/2012 TD

This report contains an updated reference range for the biomarker Homocysteine due to a laboratory equipment update. The updated reference range is based on the sex-specific 5th to 95th percentile values for men and women (20 to 39 years of age) in the NHANES nutritionally replete cohort. Annals of Internal Medicine 1999; 131 (331-338).

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.

Commentary is provided to the practitioner for educational purposes, and should not be interpreted as diagnostic or treatment recommendations. Diagnosis and treatment decisions are the responsibility of the practitioner.