Organix™
Urine Organic Acids

Your urine organic acids (Organix™) profile report contains:

- Two pages of laboratory results
- A Supplement Recommendation Summary
- This Organix Interpretive Guide booklet

YOUR LABORATORY RESULTS

The compounds that were measured in your urine specimen are reported on the laboratory results pages. The chemical names are organized into categories according to their biochemical role. The compounds on the first page are signals or markers of specific vitamin-dependent processes. The associated nutrients are listed in the parentheses under the category headings. On the second page, categories of cell regulators and toxicants are found with their associated urinary marker compounds.

In addition to the results of your measurements, the report shows a column of reference limits with H (high) or L (low) indicating abnormalities. On the right hand side are graphs showing where your values fall relative to the total patient population. These graphs are divided into five equal sections called quintiles that represent five divisions of all patients tested. Marks in the first quintile show that 80% of patients are higher than your result. If your result is near the area where most people tend to fall, then a mark will appear in the third quintile. If a mark appears in the fifth quintile, then that result is higher than for 80% of the population.

YOUR SUPPLEMENT RECOMMENDATIONS

The Supplement Recommendation Summary has two sections. The first page contains nutrients usually found in multi-vitamin-mineral products that are often the cornerstone of a nutritional treatment protocol. The suggested dose ranges vary according to the number of pertinent abnormalities found in your results. If no abnormalities are found, the entry appears in the left-hand column labeled “Base” amount. Any dose printed in the right-hand column tells you that some related abnormality was found in the Organix results. Your healthcare practitioner can build a custom program using combinations of dietary recommendations and supplements of multiple or individual vitamins.

The second page contains nutrient entries only when an abnormality is present. The nutrients included in this section are generally used as separate products as needed. The recommended dose ranges have been determined according to levels that are considered safe and effective in meeting the needs interpreted by this test alone. All amounts are adult doses and should be reduced for children according to body weight. Your healthcare practitioner may modify these recommendations according to your clinical needs.

YOUR ORGANIX™ INTERPRETIVE GUIDE

Your healthcare practitioner, with knowledge of your full medical history and concerns, can use your laboratory results to provide you with an individually optimized nutritional support program. This interpretive document is divided into major nutrient categories and individual nutrient subcategories. A summary table listing Organix compounds, or markers, and the associated nutrients is found on the next page. The paragraphs that follow explain the importance of each measured compound in ***your*** biochemistry and health, the way each compound reveals ***your*** areas of internal strengths and weaknesses, and the indications of need for specific nutrients. For each area discussed, you will find one or two representative references from the hundreds of pertinent studies in the scientific literature. Biochemical pathway charts on the last two pages further illustrate the relationships between the compounds measured in the Organix profile and the way your body uses essential nutrients in metabolism.

Metabolism is the process in which your body converts the food you eat into energy and new structures. The study of human metabolism has revealed how vitamins and minerals are used to perform those hundreds of necessary chemical reactions. For many of the organic acids that are measured, abnormally high levels in urine indicate low levels of a vitamin needed to break down that compound. This booklet translates abnormalities of organic acids into information about areas where you may need extra nutrients.

Most Significant Nutrient Associations

MEASURED COMPOUND NAME	NUTRIENT ASSOCIATIONS	METABOLIC PATHWAY
1. Adipate	L-Carnitine, Vitamin B_2	Fatty acid oxidation (Fig.4)
2. Suberate		
3. Ethylmalonate		
4. Pyruvate	Vitamins B_1, B_3, B_5, Lipoic Acid	Anaerobic energy production (Fig.4)
5. Lactate	CoQ_{10}, Vitamins B_1, B_3, B_5, Lipoic Acid	
6. β-Hydroxybutyrate	Chromium, Vanadium	Glucose uptake
7. Citrate	Arginine, Essential amino acids	Citric Acid Cycle Intermediates (Fig.4), Aerobic energy production, Renal ammonia clearance
8. Cis-aconitate	Arginine, Iron	
9. Isocitrate	Arginine, Magnesium, Manganese	
10. α-Ketoglutarate	Essential amino acids, Vitamins B_1, B_3, B_5	
11. Succinate	CoQ_{10}, Vitamin B_2, Essential amino acids, Manganese	
12. Fumarate	CoQ_{10}	
13. Malate		
14. Hydroxymethylglutarate		CoQ_{10} synthesis (Fig.4)
15. α-Ketoisovalerate	Vitamins B_1, B_3, B_5	Branched-chain amino acid catabolism
16. α-Ketoisocaproate		
17. α-Keto-β-methylvalerate		
18. Xanthurenate	Vitamin B_6	Tryptophan catabolism (hepatic) (Fig.3)
19. β-Hydroxyisovalerate	Biotin	Isoleucine catabolism
20. Methylmalonate	Vitamin B_{12}	Odd-chain fatty acid catabolism (Fig.1)
21. Formiminoglutamate	Folic acid	Histidine catabolism (Fig.2)
22. Vanilmandelate	Essential amino acids	Epinephrine, Norepinephrine catabolism

Most Significant Nutrient Associations

MEASURED COMPOUND NAME	NUTRIENT ASSOCIATIONS	METABOLIC PATHWAY
23. Homovanillate	Essential amino acids	Dopamine catabolism
24. 5-Hydroxyindolacetate		Serotonin catabolism
25. Kynurenate	Vitamin B_6	Tryptophan catabolism (Fig.3)
26. Quinolinate	Antioxidants (Vit C, Vit E, Lipoic acid)	Tryptophan catabolism (macrophage)
27. p-Hydroxyphenyllactate		Pro-oxidant and carcinogen
28. 8-Hydroxy-2'-deoxyguanosine		DNA oxidation product
29. 2-Methylhippurate	Avoidance of xylene	Hepatic Phase II conjugation
30. Orotate	Arginine, Magnesium	Urea cycle
31. Glucarate	Toxicant (xenobiotic) avoidance	Detox. liver enyme induction
32. α-Hydroxybutyrate	N-acetyl-cysteine (NAC), Glutathione, Lipoic acid	Hepatic glutathione synthesis activity
33. Pyroglutamate		Glutathione use for renal amino acid recovery
34. Sulfate		Total body glutathione status, detox. & anti-oxidant functions
35. Benzoate	Glycine	Hepatic Phase II conjugation
36. Hippurate		
37. Phenylacetate	Probiotics and antibiotics	Intestinal Bacterial Overgrowth
38. Phenylpropionate		
39. p-Hydroxybenzoate		
40. p-Hydroxyphenylactate		
41. Indican		
42. Tricarballylate		
43. D-Lactate		Intestinal Bacteria (*L. acidophillus*)
44. Dihydroxyphenylpropionate		Intestinal Bacteria (experimental)
47. D-Arabinitol	Antifungal	Yeast overgrowth

B-Complex Vitamin Markers

Vitamins are compounds that your body must have to be healthy. Vitamins are "essential" for proper function, which means that they are not made inside your body and must be consumed in the diet. The B-complex vitamins are necessary for many enzymes in your body to function properly. Your body uses enzymes to extract energy from food, to build new tissue, to remove toxins, and to maintain the immune system.

Vitamins B1, B3 and B5

Vitamins B1 (thiamin), B3 (niacin), and B5 (pantothenic acid) are some of the most easily lost vitamins. All kinds of stressors, both emotional and physical, can increase losses of B vitamins. Vitamins B1, B3, and B5 are necessary for energy pathways of all of the cells in your body. As your food is broken down, specific compounds are formed at steps that require B vitamin assistance. Such steps occur in carbohydrate breakdown where **Pyruvate** and **Lactate** are formed. Amino acids form **α-Ketoisovalerate**, **α-Ketoisocaproate**, and **α-Keto-ß-Methylvalerate**. Carbohydrate and amino acids share a common step where **α-Ketogluarate** is formed. If you have a pattern of high levels of these compounds, you may need increased intake of vitamins B1, B3, and B5.

Chuang, D.T., L.S. Ku, and R.P. Cox, Thiamin-responsive maple-syrup-urine disease: decreased affinity of the mutant branched-chain alpha-keto acid dehydrogenase for alpha-ketoisovalerate and thiamin pyrophosphate. *Proc Natl Acad Sci* USA, 1982. 79(10): p. 3300-4.

Vitamin B2

Dietary fat, carbohydrate, and protein are all broken down to produce energy using pathways that require vitamin B2 (riboflavin). If you do not have sufficient riboflavin, compounds such as **Succinate**, **Adipate**, **Suberate**, and **Ethylmalomate** are found high in urine. Some of these compounds also give information about other micronutrients that are discussed below.

Yoon, H. R., S. H. Hahn, et al. (2001). Therapeutic trial in the first three Asian cases of ethylmalonic encephalopathy: response to riboflavin. *J Inherit Metab Dis* 24(8): 870-3.

Elias, E., R. G. Gray, et al. (1997). Ethylmalonic adipic aciduria--a treatable hepatomuscular disorder in two adult brothers. *J Hepatol* 26(2): 433-6.

Vitamin B6

Your body needs vitamin B6 (pyridoxine) to utilize amino acids derived from dietary protein. Inadequate vitamin B6 is one factor that leads to increased concentrations of **Kynurenate** and **Xanthurenate** in urine. (See Figure 3) These products of amino acid breakdown cannot be further metabolized in the absence of vitamin B6. Abnormal levels of **Kynurenate** can have direct effects on brain function in addition to showing a need for vitamin B6.

Takeuchi, F., Tsabouchi, R., et al., Kynurenine metabolism and xanthurenic acid formation in vitamin B6- deficient rat after tryptophan injection. *J Nutr Sci Vitaminol* (Tokyo), 1989. 35(2): p. 111-22.

Vitamin B12 and Folic Acid

Dietary deficiency of vitamin B12 and folic acid are associated with increased risk of many diseases, including anemia and the associated chronic fatigue. You can have normal blood levels of these vitamins but still not have enough for your body's enzymes to function properly. **Methylmalonate** is a sensitive, functional marker for vitamin B12; high levels of **Methylmalonate** indicate vitamin B12 deficiency. (See Figure 1) **Formiminoglutamic acid** (abbreviated **FIGLU**) is a compound made from the amino acid histidine. (See Figure 2) Insufficiency of folic acid leads to high urinary **FIGLU**. Folic acid is especially critical for prenatal and childhood development and it is important for lowering your risk of cardiovascular disease and cancer.

Shinka, T., Y. Inoue, et al. (2002). Two cases of benign methylmalonic aciduria detected during a pilot study of neonatal urine screening. *J Chromatogr B Analyt Technol Biomed Life Sci* 776(1): 65-70.

Marin, G.H., J. Tentoni, and G. Cicchetti, [Megaloblastic anemia: rapid and economical study]. *Sangre* (Barc), 1997. 42(3): p. 235-8.

Biotin

Until recently, biotin deficiency was very difficult to determine in humans because this vitamin deficiency affects health in ways that mimic many other conditions. Doctors were likely to overlook biotin deficiency until this test was discovered. **Beta(ß)-hydroxyisovalerate** is a specific and sensitive metabolic marker for functional biotin deficiency. As your biotin intake decreases, your **ß-hydroxyisovalerate** excretion increases.

Mock, D.M., Henrich, C.L., et al., Indicators of marginal biotin deficiency and repletion in humans: validation of 3-hydroxyisovaleric acid excretion and a leucine challenge. *Am J Clin Nutr*, 2002. 76(5): p. 1061-8.

Lipoic Acid

Alpha-Lipoic acid (Lipoic acid) is classified as a "vitamin-like" compound. It is sulfur containing and is involved in energy metabolism, antioxidant protection, and insulin function. It protects cell membranes by interacting with vitamin C and glutathione. Lipoic acid has been studied as an adjunct therapy for diabetes and liver disease. The urinary markers, **Pyruvate** and **Lactate**, when elevated can indicate a need for supplemental lipoic acid.

Antioxidant Vitamin Markers

Vitamins C and E and coenzyme Q10 are grouped together because they are all involved in antioxidant protection. The special role of antioxidant vitamins is to protect your cells from damage. Without them, your rate of aging and risk of chronic disease are increased.

Vitamins C and E

Vitamin C is easily lost from the body and must be replaced frequently. Most experts agree that the average healthy person needs a minimum of 100-150 mg of vitamin C per day to stay healthy. Diseases and other stresses increase your need for vitamin C. If the cell regulator that uses vitamin C (**p-Hydroxyphenyllactate**) is high, you may need much higher vitamin C intake to restore normal metabolism and cell control.

Markaverich, B. M., R. R. Gregory, et al. (1990). Methyl p-Hydroxyphenyllactate and nuclear type II binding sites in malignant cells: metabolic fate and mammary tumor growth. *Cancer Res* 50(5): 1470-8.

Raushenbakh, M. O., V. D. Ivanova, et al. (1982). [Effect of ascorbic acid on the formation and leukemogenic action of p-hydroxyphenyl-lactic acid]. *Probl Gematol Pereliv Krovi* 27(7): 3-6.

Vitamin E is a major part of your protection from daily wear and tear. Conditions that increase oxidative metabolism tend to raise your requirements for vitamin E. High levels of **p-Hydroxyphenyllactate**, **8-Hydroxy-2'-deoxyguanosine**, **Glucarate**, and **Quinolinate** are associated with increased oxidative stress. Significant elevations in one or more of these compounds could indicate a strong need for other antioxidants as well.

Yang, C.S., Chen, W.Y., et al. (1999). Alpha-tocopherol acetate significantly suppressed the increase in heart interstitial 8-hydroxy-deoxyguanosine following myocardial ischemia and reperfusion in anesthetized rats. *Clin Chim Acta* 285(1-2): p. 163-8.

Rabinoff, M. (1994). Short note: possible role of macrophage metabolic products including quinolinic acid and neopterin in the pathogenesis of inflammatory brain diseases. *Med Hypotheses* 42(2): p. 133-4.

Coenzyme Q10

Since your body can make coenzyme Q10 it is not called a vitamin. If you are making enough to meet the demands of your tissues, you do not need to take any extra. However, many people do not make enough coenzyme Q10. Elevation of **Hydroxymethylglutarate** can reveal a block in your body's synthesis of coenzyme Q10. Other functional markers such as **Lactate**, **Succinate**, **Fumarate**, and **Malate**, indicate whether your body is able to produce energy efficiently by utilizing coenzyme Q10.

Goli, A.K., Goli, S.A., et al. (2002). Simvastatin-induced lactic acidosis: a rare adverse reaction? *Clin Pharmacol Ther* 72(4): p. 461-4.

Mineral Markers

Minerals make up about 4 to 5 percent of body weight - and not just in the skeleton! We need minerals for nerve transmission, digestion, antibody production, metabolism of nutrients, and more. Just about all of the chemical elements that are found in soil or seawater are present in your body. The ones found in very small amounts are called "trace elements."

Magnesium, Iron, and Manganese

The mineral elements magnesium, iron and manganese are additional factors that are used frequently in metabolic pathways associated with energy production. Magnesium is required for conversion of the metabolic markers **Orotate** and **Succinate**. In addition, the entire central energy pathway is dependent on iron and manganese. (See Figure 4) For most people, extra magnesium is best used as a balanced calcium-magnesium formula. Some types of heart problems are aided by using the orotate form of magnesium.

Kondrashova, M. N., V. G. Gogvadze, et al. (1982). Succinic acid oxidation as the only energy support of intensive Ca2+ uptake by mitochondria. *Biochem Biophys Res Commun* 109(2): 376-81.

Rosenfeldt, F. L. (1998). Metabolic supplementation with orotic acid and magnesium orotate. *Cardiovasc Drugs Ther* 12 Suppl 2: 147-52.

Chromium and Vanadium

The major function of chromium and vanadium is to help insulin act on your cells to regulate blood sugar. Unless you have been on a very low carbohydrate diet, **Beta(β)-Hydroxybutyrate** is a metabolic marker of blood sugar utilization and insulin function. Elevated **β-Hydroxybutyrate** is a sign that extra chromium and vanadium may be warranted.

Bahijri, S. M. and A. M. Mufti (2002). Beneficial effects of chromium in people with type 2 diabetes, and urinary chromium response to glucose load as a possible indicator of status. *Biol Trace Elem Res* 85(2): 97-109.

Pandey, S. K., M. B. Anand-Srivastava, et al. (1998). Vanadyl sulfate-stimulated glycogen synthesis is associated with activation of phosphatidylinositol 3-kinase and is independent of insulin receptor tyrosine phosphorylation. *Biochemistry* 37(19): 7006-14.

Amino Acid Markers

Amino acids have many important functions in the body including the regulation of muscle and hormone activity and the formation and maintenance of every tissue in your body (i.e., bone, ligaments, tendons, muscle). Essential amino acids are those that your body cannot make, so they must be obtained from your diet. Conditions like chronic stress, depression, and toxic chemical exposure increase your needs for various amino acids.

Carnitine

Carnitine helps your body use fatty acids for energy. The body makes small amounts of carnitine, but if it is not enough, fatty acids are not normally processed and urinary excretion of the by-products **Adipate** and **Suberate** increase. **Ethylmalonate,** which comes from a different carnitine-dependent pathway, would also accumulate with carnitine insufficiency.

Bohles, H., Z. Akcetin, et al. (1988). "The influence of i.v. MCT and carnitine on the excretion of dicarboxylic acids." *Beitr Infusionther Klin Ernahr* 20: 69-74.

Arginine

Arginine is a conditionally essential amino acid that is critical for your cardiovascular health and detoxification functions. The amino acid arginine is used to make the powerful blood vessel regulator nitric oxide. Nitric oxide acts to lower blood pressure. Too little arginine can lead to high blood pressure. Too much arginine can lead to increased aging from oxidative damage. High **Citrate**, **Isocitrate**, **Cis-aconitate**, or **Orotate** can indicate arginine insufficiency.

Sass, J.O. and D. Skladal, Plasma concentrations and renal clearance of orotic acid in argininosuccinic acid synthetase deficiency. *Pediatr Nephrol*, 1999. 13(9): p. 912-6.

5-Hydroxytryptophan

5-Hydroxytryptophan (5-HTP) is an intermediate in the production of serotonin. Acting as a neurotransmitter, serotonin controls functions relating to mood, behavior, appetite, sleep, and bowel contractions. The compound **5-Hydroxyindoleacetate** (**5-HIA**) is measured in urine as a marker of serotonin metabolism. When this compound is elevated it indicates higher than normal turnover of serotonin with potential depletion of tryptophan as a result. 5-HTP can be used as a dietary supplement to increase production of serotonin as therapy for individuals who are depressed, have sleep problems, or chronic pain such as fibromyalgia. Serotonin re-uptake inhibitors (Prozac, Zoloft, etc.) often lead to elevated **5-HIA**.

Birdsall, T.C., 5-Hydroxytryptophan: a clinically-effective serotonin precursor. *Altern Med Rev*, 1998. 3(4): p. 271-80.

Glycine

Glycine is an amino acid serving several important purposes within the body, including detoxification, DNA formation, the synthesis of hemoglobin, and as a part of brain neurotransmission pathways. In the liver, glycine helps to convert many potentially harmful substances including toxic materials such as benzoic acid (**Benzoate**) into harmless forms. If urinary **Benzoate** levels are elevated, it suggests you may benefit from extra glycine. A second detoxification role of glycine is to serve as a necessary part of glutathione, a compound needed by the liver. Urinary **Pyroglutamate** levels reflect loss of glutathione available to the body that improves when extra glycine is provided.

Temellini, A., Megarero, S., et al., Conjugation of benzoic acid with glycine in human liver and kidney: a study on the interindividual variability. *Xenobiotica*, 1993. 23(12): p. 1427-33.\

Persaud, C., T. Forrester, et al. (1996). Urinary excretion of 5-L-oxoproline (pyroglutamic acid) is increased during recovery from severe

childhood malnutrition and responds to supplemental glycine. *J Nutr* 126(11): 2823-30.

N-Acetylcysteine or Other Sulfur-containing Amino Acids

Dietary intake of sulfur-containing amino acids like cysteine is also required to maintain your levels of glutathione. Glutathione is constantly used up in the removal of toxic molecules and prevention of oxidative damage. **α-hydroxybutyrate** is a by-product from the process in which the body forms more glutathione. When that process is running at high rates α-hydroxybutyrate excretion is increased. Elevated levels of the marker **Pyroglutamate** reveal that glutathione is being lost at a high rate. **Sulfate** excretion is another way to check your total body sulfur-containing amino acid status. High rates of glutathione synthesis under conditions of high oxidative stress can cause high urinary sulfate levels. Low urinary sulfate is an indication that total body glutathione is low and sulfur-containing amino acids are needed. The amino acid N-acetylcysteine is one effective agent for raising your glutathione and sulfate levels. Another sulfur-containing nutrient, lipoic acid, should always be considered when there is evidence of detoxification stress on the liver. The ability of the liver to regenerate antioxidants like vitamin C is dependent on lipoic acid.

Kim, H. J., J. H. Cho, et al. (1995). Depletion of hepatic 3'-phosphoadenosine 5'-phosphosulfate (PAPS) and sulfate in rats by xenobiotics that are sulfated. *J Pharmacol Exp Ther* 275(2): 654-8.

Lykkesfeldt, J., T. M. Hagen, et al. (1998). Age-associated decline in ascorbic acid concentration, recycling, and biosynthesis in rat hepatocytes--reversal with (R)-alpha-lipoic acid supplementation. *Faseb J* 12(12): 1183-9.

Essential Amino Acid Markers

The energy pathways in your cells require the key compounds **Citrate**, **α-Ketoglutarate**, and **Succinate**, which are formed from essential amino acids. ***Low*** levels of **Citrate**, **α-Ketoglutarate**, and **Succinate** may indicate amino acid imbalances that can affect your energy pathways. (See Figure 4)

Teplan, V., Schuck, O., et al. (2001). Metabolic effects of keto acid--amino acid supplementation in patients with chronic renal insufficiency receiving a low-protein diet and recombinant human erythropoietin--a randomized controlled trial. *Wien Klin Wochenschr* 113(17-18): P. 661-9.

Your nervous system, including the brain, uses certain amino acids to make chemicals called neurotransmitters that act to stimulate nervous signals. Several antidepressant drugs act in such a way that essential amino acids are lost due to increased metabolic activity to produce neurotransmitters. Your body's responses to stress also can increase the production of neurotransmitter and hormonal signals indicated by the compounds analyzed here. They include the neurotransmitter breakdown products **Vanilmandelate**, **Homovanillate**, and **5-Hydroxyindoleacetate** that appear in urine. They come from neurotransmitters called epinephrine, dopamine, and serotonin.

Williams, W. A., S. E. Shoaf, et al. (1999). Effects of acute tryptophan depletion on plasma and cerebrospinal fluid tryptophan and 5-hydroxyindoleacetic acid in normal volunteers. *J Neurochem* 72(4): 1641-7.

Increased intake of the amino acids tyrosine and 5-hydroxytryptophan may be needed when neurotransmitter markers are abnormal. Supplemental essential amino acids can greatly benefit people who don't adequately digest protein or who have increased demand for specific amino acids to maintain body processes.

Environmental Toxin Exposure Markers

One of the most common organic compounds in our environment is xylene. Produced from coal tar or crude oil, xylene is used as a solvent for paints and paint thinners, and its vapors are released from many building and decorating materials such as varnishes and new carpets. Your excretion of **2-Methylhippurate** is a sensitive and specific marker for xylene exposure. **Glucarate**, on the other hand, serves as a biomarker for your exposure to a wide array of potentially toxic chemicals. High urinary **Glucarate** suggests above normal exposure to pesticides, herbicides, fungicides, petrochemicals, alcohol, pharmaceutical compounds, or toxins produced in the gastrointestinal tract.

Ferreira, M., Jr., Buchet, J. P., et al. (1994). Determinants of urinary thioethers, D-glucaric acid and mutagenicity after exposure to polycyclic aromatic hydrocarbons assessed by air monitoring and measurement of 1-hydroxypyrene in urine: a cross-sectional study in workers of coke and graphite-electrode-producing plants. *Int Arch Occup Environ Health*. 65(5): p. 329-38.

Intestinal Microbial Balance Markers

The compounds in this category normally appear in urine only at low levels. With the exception of hippurate, the compounds are not normally produced in the cells of your body. However, unfriendly intestinal microorganisms can manufacture them in relatively high quantities. The compounds are then absorbed into the blood from the intestines and eventually appear in the urine. Microbial overgrowth can lead to a wide variety of symptoms due to reactions to the toxic products produced by bacteria, parasites, or fungi. Various patterns of the compounds listed below appear elevated in conditions of general intestinal microbial overgrowth.

Probiotics and Antibiotics

In health, beneficial intestinal bacteria produce some B vitamins and provide stimulus for proper immune function. However, if your stomach acid is not adequate, if you fail to digest protein, or if your diet does not supply sufficient fiber, the resulting overgrowth of unfavorable bacteria can release toxic products that your body must remove. These toxic products include: **Benzoate**, **Hippurate**, **Phenylacetate**, **Phenylproprionate**, **p-Hydroxybenzoate**, **p-Hydroxyphenylacetate**, **Indican**, and **Tricarballylate**. Your potential to benefit from consuming extra sources of favorable organisms (called probiotics) may go up as the number of toxic compounds and their concentrations increase.

Valkova, N., F. Lepine, et al. (2001). Hydrolysis of 4-hydroxybenzoic acid esters (parabens) and their aerobic transformation into phenol by the resistant Enterobacter cloacae strain EM. *Appl Environ Microbiol* 67(6): 2404-9.

Tohyama, K., Y. Kobayashi, et al. (1981). Effect of lactobacilli on urinary indican excretion in gnotobiotic rats and in man. *Microbiol Immunol* 25(2): 101-12.

D-Lactate elevation is an exception to the rule for probiotic potential just described. *Lactobacillus acidophilus* is widely considered a favorable bacterium to colonize the human gut. It has beneficial effects in many individuals. However, if you have any tendency for carbohydrate malabsorption, even favorable organisms (*e.g., L. acidophilus*) can grow so fast that your blood becomes highly acidic due to the formation of **D-Lactate**. This condition is revealed by high **D-Lactate** in urine. Discontinuing all probiotic intervention, while considering antibiotic therapy may be warranted when **D-Lactate** is high.

Vella, A. and G. Farrugia, D-lactic acidosis: pathologic consequence of saprophytism. *Mayo Clin Proc*, 1998. 73(5): p. 451-6.

Godey, F., A. Bouasria, et al. (2000). Don't forget to test for D-lactic acid in short bowel syndrome. *Am J Gastroenterol* 95(12): 3675-7.

It is difficult to know the exact identification of organisms that may be producing the compounds found in your urine. However, one specific compound, **Dihydroxyphenylpropionate** seems to be strongly associated with a particularly troublesome type of bacteria called *Clostridia*. This organism is frequently the cause of travelers diarrhea, but its by-products may produce other symptoms. Species of *Clostridia* are particularly susceptible to displacement by the favorable organism called *Saccharomyces boulardii* that is available in capsules.

Schwarz, G., R. Bauder, et al. (1989). Microbial metabolism of quinoline and related compounds. II. Degradation of quinoline by Pseudomonas fluorescens 3, Pseudomonas putida 86 and Rhodococcus spec. B1. *Biol Chem Hoppe Seyler* 370(11): 1183-9.

Yeast is another class of microbes that can chronically grow in the intestinal tract and cause health effects through the release of toxic metabolites. Because of the multiple, non-specific symptoms that they can produce, doctors have searched for ways to know when yeast overgrowth is a problem. **D-Arabinitol** is uniquely produced by intestinal yeast, and the degree of elevation is a useful marker of their growth. Favorable organisms and herbal or pharmaceutical antifungal agents suppress intestinal yeast.

For Further Information:

This and other laboratory tests for functional nutrient insufficiency are discussed in the following book that may be ordered at www.metametrix.com.

Bralley, J. A. and R. S. Lord (2000). Laboratory Evaluations in Molecular Medicine: Nutrients, Toxicants and Cell Regulators, Inst Adv Molec Med, Norcross, GA.

Uribarri, J., M.S. Oh, and H. J. Carroll, *D-lactic acidosis. A review of clinical presentation, biochemical features, and pathophysiologic mechanisms.* Medicine (Baltimore), 1998. 77(2): p. 73-82.

Figure 1. Methylation Cofactor Markers - Vitamin B12

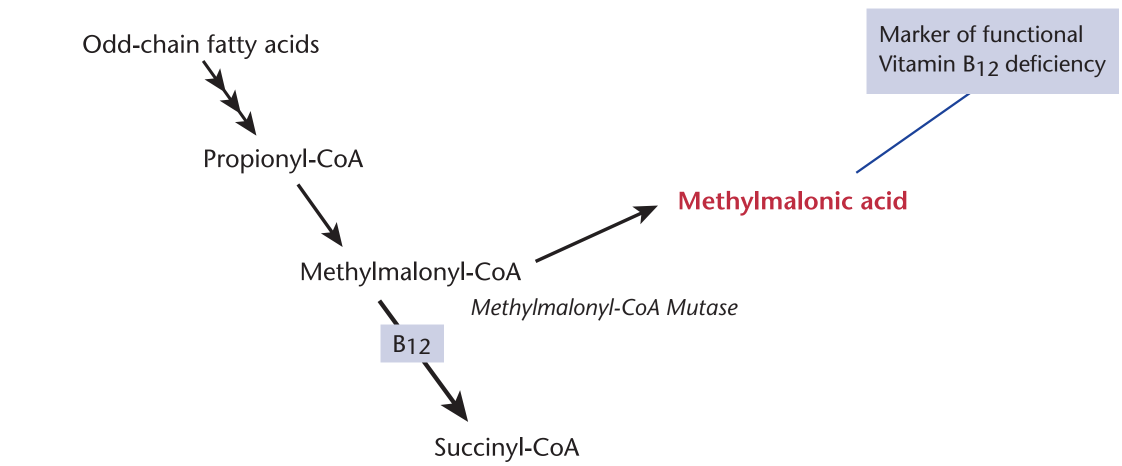


Figure 2. Methylation Cofactor Markers - Folic Acid

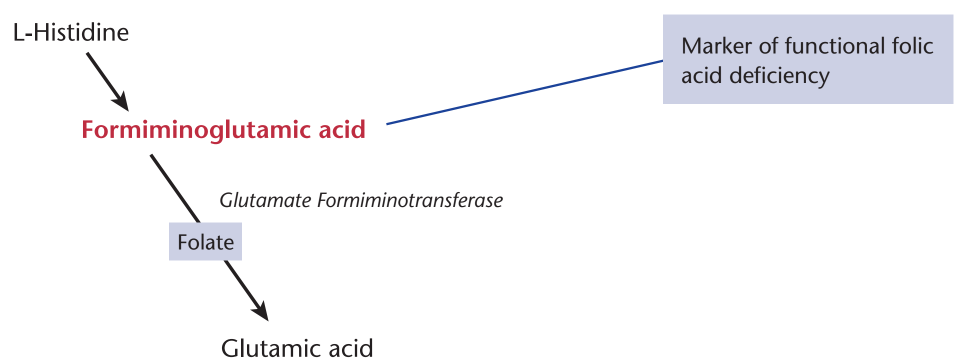
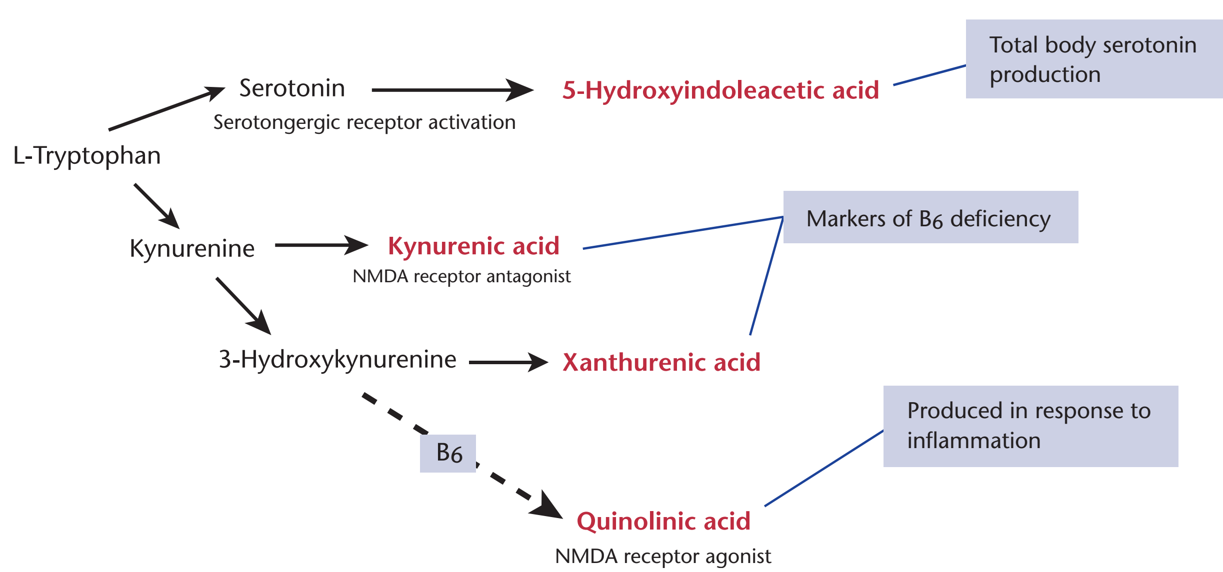


Figure 3. Tryptophan Pathways in Vitamin B6 Deficiency and Inflammation



Compounds Reported in Organix™ Profile Are Printed in Red