



## ORGANIC ACIDS – Citric Acid Cycle (urine)

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*The organic acid test is a nutritional test providing insights into the body's cellular metabolic processes. Urinary organic acids derived from the metabolic conversion of dietary proteins, fats and carbohydrates, in addition to compounds of bacterial origin, provide a unique chemical profile of a patient's cellular health. The testing procedure measures the overflow or build-up of intermediate organic acid products in the urine, determining where 'aberrations' are occurring in metabolic pathways. These biomarkers give an overview of several major systems in the body and an analysis of nutritional deficiencies in the body.*

The Organic Acids test is the preferred test used in clinical practice as many functional medicine practitioners believe the metabolic panel provides remarkable data about a patient from a simple urine collection. The organic acid tests assess a wide range of cellular and physiological processes including intestinal dysbiosis, energy production, nutrient cofactor requirements and neurotransmitter metabolism.

Marked accumulation of specific organic acids detected in urine often signals a metabolic inhibition or block. The metabolic block may be due to a nutrient deficiency, an inherited enzyme deficit, toxic build-up or drug effect. By evaluating organic acid levels and pinpointing the metabolic dysfunctions occurring at the cellular level, a comprehensive, customised treatment strategy can be tailor made for each individual patient.

### **Citric Acid Cycle**

The citric acid cycle is a critical component for macronutrient metabolism and energy conversion for all nutrients. The complete metabolism for each nutrient must go through the citric acid cycle. This cycle is also an important source of biosynthetic building blocks used in gluconeogenesis, amino acid biosynthesis and fatty acid biosynthesis. The citric cycle takes place in mitochondria where it oxidises acetyl-CoA, extracting energy with NADH (nicotinamide adenine dinucleotide) and FAD (flavin adenine dinucleotide).

Acetyl-CoA, a key metabolic junction, is catalysed by citrate synthase to oxidise the metabolic intermediates releasing two carbon dioxide molecules for each acetyl-CoA. This carbon dioxide, along with more released by pyruvate dehydrogenase, is the source of CO<sub>2</sub> released into the atmosphere when you breathe. Citrate synthase, alpha-ketoglutarate dehydrogenase and isocitrate dehydrogenase are all key regulatory steps in the cycle and are each inhibited by abundant energy in the cell, indicated through high concentrations of ATP or NADH.

Citric cycle enzymes require specific amino acids and vitamins as cofactors for activity. Insufficient levels of amino acids and vitamins in the diet leads to decreased activity of the Krebs cycle.

## The Ideal Test for Complex Patients

Medically unexplained symptoms account for approximately 20% of primary care consultations and 10% of secondary care referrals. The typical symptom clusters including emotional and mental difficulties, allergic reactions, gastrointestinal distress, and urinary tract problems do not fit any traditional disease pattern, nor do they have an agreed-upon conventional medical diagnosis. In these situations the organic acid tests would be an ideal diagnostic test to utilize. This test brings new tools to the practitioner.

CONDITIONS WHICH MAY BENEFIT FROM ORGANIC ACID TESTING	
Allergies	Anaemia
Autism	Blood sugar irregularities
Cardiovascular disease	Chemical sensitivities
Depression / Anxiety	Dermatitis
Fatigue	Hyperactivity
Insomnia	Irritable Bowel Syndrome
Malabsorption and maldigestion	Mental or developmental delay
Mood disorders	Muscle pain
Autoimmune disorders	Inflammation

## ORGANIC ACIDS – CITRIC ACID CYCLE [Test code: 4013]

- ❖ Lactic acid, Pyruvic acid, Citric acid, cis-aconitic acid, Isocitric acid,  $\alpha$ -ketoglutaric acid, Fumaric acid, Malic acid

## Other organic acids tests available

- **Organic Acids, Metabolic Profile [4016]:** Measures 34 organic acids for analysing bacterial dysbiosis, yeast & fungal dysbiosis, citric acid metabolites, ketone/fatty acid metabolites, cofactor sufficiency markers and neurotransmitter metabolites.
- **Organic Acids, Methylation Cofactors [4018]:** Formiminoglutamic acid (FIGLU), Methylmalonic acid (MMA)
- **Organic Acids, Ketone, Fatty Acid Metabolites [4015]:** Adipic acid, Suberic acid,  $\beta$ -hydroxy- $\beta$ -methylglutaric acid (HMG),  $\beta$ -hydroxybutyric acid
- **Organic Acids, Environmental Pollutants [4014]:** Measures 11 organic acids which analyse exposure to benzene, xylene, toluene, trimethylbenzene, styrene and phthalate.
- **Organic Acids, Metabolic Profile + Environmental Pollutants [4017]:** This panel includes both Metabolic Profile and Environmental Pollutants analytes as above.

## How to order a test kit:

To order a test kit simply request the test name and/or test code on a NutriPATH request form and have the patient phone NutriPATH Customer Service on 1300 688 522.



Phone 03- 2727 7434 for further details  
[www.malysialaboratory.com](http://www.malysialaboratory.com)

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