

Magnesium and Malic Acid Enhance ATP and Related Energy Factors

Universal Energy Source for the Body: Adenosine Triphosphate (ATP)

ATP, adenosine triphosphate, is the substance which stores energy that is created when the body burns carbohydrates and fats in the citric acid cycle. When energy is needed by the body (as, for example, in muscular contraction), ATP is broken down to release the stored energy. ATP is the universal energy molecule for the body in the same way that electricity is the universal energy source for a computer.

Chronic Fatigue, Fibromyalgia and Related Conditions Respond to Magnesium and Malic Acid

According to the CFS Research Foundation in Santa Barbara, California, Chronic Fatigue Syndrome (CFS) specialists are now recommending a malic acid/magnesium hydroxide complex for the treatment of CFS and related pain of primary fibromyalgia. Dr. Daniel Peterson, a pioneer in CFS research, states, "...approximately 40% of those who have tried this supplement show some type of benefit." Dr. Jay Goldstein of Los Angeles has found magnesium and malic acid to be a safe, in-

ATP•PLUS
Magnesium Hydroxide & Malic Acid
Hypoallergenic Vegetarian Formula
Product No. 495 Fill Size: 90 Vegetable Capsules
NDC 051821-495-90
Three Capsules Contain:
Magnesium (Hydroxide) 300 mg.
Malic Acid 1200 mg.
Suggested Usage: One capsule three times daily.

expensive supplement and recommends that it be added to the list of potential beneficial substances for chronic fatigue.⁽¹⁾

Fibromyalgia (FM) is a clinical syndrome of generalized musculoskeletal pain, stiffness and chronic aching, common in middle-aged women (between the ages of 30 and 50).⁽²⁾ The association of FM with irritable bowel syndrome, tension headache, dysmenorrhea^(2,3), mitral valve prolapse^(2,4) and chronic fatigue syndrome^(2,5) has been reported.

In a clinical test with 15 FM patients using a total daily dosage of 300-600 mg. of elemental magnesium and 1200-1400 mg. of malic acid, all patients reported significant improvement of pain within 48 hours of starting the supplement. After an average of eight weeks on the supplement, six patients were switched to a placebo. Myalgia recurred within 48 hours in all patients on the placebo.⁽²⁾ Fatigue symptoms may take approximately 2 weeks to respond to the supplement.⁽¹⁾

Researchers now believe that FM and related symptoms may be a result of deficiencies of substances needed for ATP synthesis. Synthesis of proteins, fats and carbohydrates necessary for cellular integrity, normal activity and function is dependent on ATP availability which supplies the energy for their synthesis and actions.⁽²⁾

The synthesis of ATP by intact respiring mitochondria requires the presence of oxygen, magnesium, substrate, ADP and inorganic phosphate. The ingredients required for ATP synthesis are listed in the table on the left, together with some conditions which may cause a deficiency of each of these.⁽²⁾

Requirements for Optimal Synthesis of ATP⁽²⁾

Requirement	Conditions Postulated to Cause ATP Deficiency
Oxygen	Hypoxia Malate Deficiency Magnesium Deficiency
Magnesium	Excess Aluminum Excess Calcium
Substrate	Severe Malnutrition Malate Deficiency
ADP	Phosphate Deficiency Magnesium Deficiency
Inorganic Phosphate	Magnesium Deficiency Malate Deficiency Excess Calcium Excess Aluminum
Capacity of the Respiratory Chain	Thiamine, riboflavin and pyridoxine are essential for the electron transport system in the respiratory chain. All three vitamins require a magnesium dependent phosphate transfer reaction to become biologically active.
Mitochondrial Membrane Integrity	Magnesium deficiency causes mitochondrial swelling, increases membrane permeability and uncoupling of oxidative phosphorylation.

(over)

Magnesium and Malic Acid Essential in Aerobic and Anaerobic Reactions Necessary for ATP Synthesis

Magnesium and malic acid are essential in both aerobic and anaerobic reactions necessary for the production of ATP. Both substances also have an oxygen sparing effect. It is plausible, therefore, that magnesium and malate deficiency could induce hypoxia as seen in muscle tissue biopsies of FM patients.⁽²⁾

Magnesium and malic acid can protect against the toxic effects of aluminum. Because of its affinity for phosphate groups, aluminum blocks the utilization of phosphate for ATP synthesis. Adequate magnesium levels prevent this toxic effect. Malic acid is one of the most potent chelators of aluminum and was the most effective of several chelators tested at reducing aluminum levels in the brain.⁽²⁾

Sufficient Magnesium Is Critical

Magnesium may be the most critical supplement for CFS patients.⁽⁶⁾ Magnesium supplementation for CFS, FM and related symptoms are well supported by research.

- Known intracellular magnesium deficiencies exist in CFS and such deficiencies definitely disrupt ATP synthesis in both the glycolytic and mitochondrial pathways.⁽⁶⁾
- Since ATP drives the membrane pumps which transport magnesium into the cell, a vicious cycle could arise in which low ATP levels give rise to even lower intracellular magnesium, causing still further ATP reduction. This may in fact occur in CFS patients who "crash".⁽⁶⁾
- The most common symptoms associated with FM—myalgia, chronic fatigue syndrome, irritable bowel syndrome, mitral valve prolapse, tension headache and dysmenorrhea—have been reported in patients with magnesium deficiency, and magnesium supplementation improves these symptoms.⁽²⁾
- The oxygen sparing effect of magnesium has been demonstrated in magnesium deficient swimmers. Magnesium supplementation lowered blood lactate levels and oxygen consumption despite a higher glucose utilization.⁽²⁾
- Magnesium deficiency causes swelling and disruption of cristae in the mitochondria, with a decreased number of mitochondria per cell. Similar mitochondrial abnormalities have been reported in muscle biopsies of FM patients.⁽²⁾
- Magnesium is required for the normal activity of malate dehydrogenase involved in malate-aspartate shuttle.⁽²⁾

Malate Deficiency May Be the Cause of Physical Exhaustion

It has been proposed that malate deficiency may be the cause of physical exhaustion and that malate is the common mediator of increased mitochondrial respiration. Malate is the only metabolite of the citric acid cycle which correlates positively with physical activity.

- Following endurance training of athletes, muscles were characterized by a 50% increase in the malate-aspartate redox shuttle enzymes, where malate plays a key role.⁽²⁾
- Only tissue malate is depleted following exhaustive physical activity, even though other key metabolites from the citric acid cycle necessary for ATP production remain unchanged.⁽²⁾
- In humans as well as in other animals tested, when there is increased demand for ATP, there is also an increased demand and utilization of malate.⁽²⁾
- Under aerobic conditions, the oxidation of malate to oxaloacetate provides reducing equivalents to the mitochondria by the malate-aspartate redox shuttle.⁽²⁾
- Under anaerobic conditions, an excess of cytosolic reducing equivalents inhibits glycolysis. By its simultaneous reduction to succinate and oxidation to oxaloacetate, malate is capable of removing cytosolic reducing equivalents, thereby reversing inhibition of glycolysis.⁽²⁾

WARNING: This information is provided for health care professionals only. This publication and the product contained herein have not been approved or evaluated by the Food and Drug Administration. This publication, and the product contained herein are not intended to diagnose, treat, cure or prevent any disease. The product relates to nutritional support only.

REFERENCES

1. "A Follow-Up on Malic Acid" CFIDS Buyers Club, Health Watch, Spring, 1993;3(1):1,3.
2. Abraham, G.E. and Flechas J.D., "Management of Fibromyalgia: Rationale for the use of Magnesium and Malic Acid", Journal of Nutritional Medicine, 3:49-59, 1992.
3. Yunus, M., Raman K., Raman, K.K., "Primary fibromyalgia syndrome and myofascial pain syndrome: Clinical features and muscle pathology", Arch Phys Med. Rehab., 69:451-4, 1977.
4. Pelligrino, M., Van Fossen, D., Gordon, C., Ryan, J., Waytonis, G., "Prevalence of mitral valve prolapse in primary fibromyalgia: a pilot investigation, Arch. Phys. Med. Rehab., 70:541-3, 1988.
5. Goldenberg, D., Simms, R., Geiger, A., Komaroff, A., "High frequency of fibromyalgia in patients with chronic fatigue seen in primary care practice," Arth. Rheum. 3:381-7, 1990.
6. Cheney, P., Lapp, C., "Entero-Hepatic Resuscitation in Patients with Chronic Fatigue Syndrome: A Pyramid of Nutritional Therapy", CFIDS Buyers Club, Health Watch, Winter, 1994;4(1):3.

PROGRESSIVE LABORATORIES, INC.

1701 W. Walnut Hill Lane • Irving, Texas 75038 • Phone: 972-518-9660 • Fax: 972-518-9665

TOLL FREE: 1-800-527-9512 or 1-888-PRO-LABS (776-5227)