



## **Acetyl-L-Carnitine (ALC) L-Carnitine Carnitine Propionyl-L-carnitine (PLC) Isovaleryl-carnitine**

### **Common Indications:**

- Cardiovascular energy and peripheral artery health
- Diabetes
- Male fertility
- Carnitine deficient diet (vegan)
- Hepatic encephalopathy
- Antioxidant
- Hyperthyroidism
- Fat transport and ATP production

### **General Comments:**

L-carnitine is a trimethylated amino acid that works in cellular energy production within the mitochondrial matrix. Carnitine is an antioxidant that is reported to help regulate fat metabolism by facilitating the transport of fats and cholesterol across cell membranes in the mitochondria thus improving the production of energy (ATP). This may in fact enhance cellular oxygenation. L-carnitine is found in red meat, avocado and tempeh.

### **Benefits & Mechanism of Action:**

#### Cardiovascular

Chronic stable angina: Studies found that L-carnitine supplementation increased exercise tolerance and reduced angina attacks. Studies using patients with chronic stable angina taking 2g L-carnitine daily for 3 months found a moderate improvement in duration of exercise and time taken for ST changes to recover to baseline.<sup>14</sup>

Post myocardial infarction: Studies found L-carnitine 4g daily for 12 months in patients with acute MI improved their quality of life and increased life expectancy.<sup>10</sup>

Cardiomyopathy: causes leakage of carnitine from heart stores.<sup>2</sup> Studies found that patients with heart failure due to cardiomyopathy taking 2g L-carnitine daily for 10-54 months had an increased advantage in survival rates.<sup>22</sup>

Peripheral vascular disease: Studies found that taking 2g L-carnitine daily for 3 weeks increased walking time in people with peripheral vascular disease.<sup>5</sup>

Hypertension: Studies investigating the components of metabolic syndrome in non-diabetic patients taking 2g acetyl-L-carnitine daily for 24 weeks found a significant reduction in arterial blood pressure.<sup>23</sup>

## Diabetes

A 2013 systemic review and meta-analysis reported that oral L-carnitine lowers fasting plasma glucose as well as all significant lipid markers such as total cholesterol, low density lipoprotein, apolipoprotein-B100, and apolipoprotein-A1 . The changes in triglycerides, lipoprotein (a) or HbA1c were not significant. The administration of L-carnitine in type 2 diabetes mellitus is associated with an improvement plasma lipids and glucose control. <sup>26</sup>

## Male Fertility

In a placebo-controlled, double-blind crossover trial in 100 infertile males found that supplementation with 2g L-carnitine daily effectively improved semen quality, sperm concentration and total and forward sperm motility.<sup>17</sup> A meta-analysis that compared L-carnitine and acetyl-L-carnitine therapy to placebo which found improvements in pregnancy rates, total sperm motility, forward sperm motility and atypical sperm cells.<sup>28</sup>

## Carnitine Deficiency

Carnitine deficiency can occur in vegetarians, preterm infants, infants receiving carnitine-free formula, inborn errors of metabolism and hemodialysis. Studies found that 50-200 mg/kg/day L-carnitine supplementation can normalize plasma levels within 10 days.<sup>7</sup>

## Hepatic Encephalopathy

Studies in patients with hepatoencephalopathy taking 2g acetyl-L-carnitine twice daily versus placebo found a significant decrease in mental and physical fatigue with the acetyl-L-carnitine group. The active group also had an increase in physical activity.<sup>18</sup>

## Antioxidant

Carnitine works as an antioxidant by preventing protein oxidation and pyruvate and lactate oxidative damage. It was also found to help decrease lipid peroxidation and beta-oxidation.<sup>18</sup>

## Hyperthyroidism

Low body stores of carnitine have been associated with hyperthyroidism. In vivo studies have shown L-carnitine to have antagonistic effects to thyroid hormone. Studies found that 2 or 4 grams of oral L-carnitine in women with induces suppression of thyroid-stimulating hormone had a beneficial effect on reversing and preventing symptoms of hyperthyroidism.<sup>4</sup>

## Dose:

- Deficiency: 50-200mg/kg/day

- Most conditions: L-carnitine 2-4g/day in divided doses

#### **Cautions & Side Effects:**

- CAUTION in chronic liver disease- may impair metabolism or increase biosynthesis of L-carnitine.
- CAUTION in seizures- may lower seizure threshold

#### **Symptoms of Depletion:**

- A deficiency of L-carnitine may result in muscle weakness, fatty acid abnormalities and problems with glucose control.
- Acetyl-L-carnitine (ALC) may be depleted by valproic acid and zidovudine. When using these and similar medications, supplementation with ALC may be warranted. The frequency of depression in HIV/AIDS patients is correlated with low levels of L-carnitine (Rezaee et al, 2013). **Toxicities, Warnings and Interactions:**

- There is no known toxicity when using acetyl-L-carnitine as a dietary supplement.
- There are reports and a study that suggests carnitine in red meats may increase the risk of developing atherosclerosis (Koeth et al, 2013). The authors reported that the microfloral metabolism of L-carnitine and/or choline in the human gut produces trimethylamine (TMA), which is further metabolized to the proatherogenic compound trimethylamine-N-oxide (TMAO). However, many foods can produce TMAO, including potatoes, peas, carrots and seafood, so the link between carnitine, red meat and atherosclerosis remains questionable.
- ALC should not be used during pregnancy or lactation. **Food Sources:** L-carnitine is only found in animal food sources such as meat, poultry, and dairy products. Human breast milk is an important source of L-carnitine for infants.

#### **Cautions & Side Effects:**

- If you are taking prescription or non-prescription medications or have a pre-existing medical condition, talk with your healthcare provider before taking any dietary supplement.
- Do not use if you are pregnant or breastfeeding.
- Do not take if there is an allergy to any component of this dietary supplement. **DISCLAIMER:** Statements made are for educational purposes and have not been evaluated by the US Food and Drug Administration. They are not intended to diagnose, treat, cure, or prevent any disease. If you have a medical condition or disease, please talk to your doctor prior to using the recommendations given.

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