

## High-dose carnitine to support fat loss, mitochondrial function and sustained energy\*

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Ribo-CarniClear™ is a supersaturated liquid form of the amino acid derivative carnitine with a pleasant orange flavor. This product is ideal when convenient and economical high-dose carnitine supplementation is indicated. Each one-teaspoon serving provides 2 grams of L-carnitine along with 2 grams of D-ribose and 100 mg of pantothenic acid to support healthy energy levels and the metabolism of fats. This product is an excellent choice for individuals who consume little or no meat or who need support for cellular energy generation. It is best taken on an empty stomach.

L-carnitine is a compound naturally occurring in all foods, but significant amounts are found only in animal foods, particularly dark meats such as red meat (beef, lamb, bison), dark meat poultry, and pork and fish, due to high concentrations of mitochondria. (The name *carnitine* is derived from its first having been isolated from meat.) Carnitine supplementation may be particularly warranted in vegetarian and strict vegan diets because neither preformed carnitine nor its precursor amino acids are present in adequate amounts to support optimal health.

The human body synthesizes carnitine from lysine and methionine, with iron, niacin, and vitamins C and B6 as cofactors. (The fatigue associated with vitamin C deficiency is believed to result from decreased carnitine synthesis.) Carnitine may be considered a conditionally essential amino acid (although not a true amino acid) because this relatively limited synthesis may not be adequate during periods of increased demand and under certain metabolic states.<sup>1</sup> Carnitine is synthesized primarily in the liver and kidneys but over 95% of the body's carnitine is located in the heart and skeletal muscle owing to their high energy demands and their use of fatty acids as their primary fuel.

### Fat burning, weight loss and exercise recovery

Carnitine's fundamental physiological role is in facilitating the  $\beta$ -oxidation of long-chain fatty acids by enabling transport of these molecules across the inner and outer mitochondrial membranes. Owing to this function, supplemental carnitine may be beneficial in circumstances that require enhanced oxidation of fat, such as obesity, high triglycerides, sustained exercise (aerobic or resistance training), and low-carbohydrate or ketogenic diets.\*

In a small cohort of healthy women, compared to placebo, carnitine supplementation was shown to increase serum levels of the ketone body beta-hydroxybutyrate (suggesting greater fat mobilization), which were elevated further by the addition of exercise.<sup>2</sup> Other studies confirm the finding that carnitine supplementation increases fatty acid oxidation even in subjects who are not carnitine deficient<sup>3</sup>, suggesting a potential role for supplemental carnitine in assisting with fat loss.

In a study of overweight subjects following a 1200-calorie/day diet and exercise program for four weeks, compared to placebo, carnitine supplementation resulted in greater reduction in body weight and BMI. The carnitine group lost an average of 2 pounds more than the placebo group—an amount that could be substantial over a longer period of time.<sup>4</sup> (The study diet was 50-55% carbohydrate, 30-35% fat and 15% protein. Results may have been even more significant if the experimental diet was lower in carbohydrate.)

Fat oxidation is increased relative to glucose use during endurance exercise, and carnitine has been shown to increase the efficiency of this process. Some researchers speculate that with carnitine controlling fatty acid entry into the mitochondria, the availability of free carnitine may regulate fatty acid use in skeletal muscle during exercise.<sup>5</sup> Among healthy young men engaged in strenuous exercise, compared to placebo, carnitine supplementation resulted in a significantly lower respiratory quotient (RQ), indicating a shift to greater fat oxidation<sup>6</sup>, confirming findings from earlier studies.<sup>7</sup> This effect of carnitine on fat oxidation means that for a given amount of energy required during an exercise session, carnitine increases the proportional fuel use from fat rather than from carbohydrate, which may support increased fat loss.

### Ribo-CarniClear™ may be beneficial for those with\*:

- Obesity
- Fibromyalgia
- Chronic fatigue syndrome
- Congestive heart failure
- Ischemic cardiovascular disease
- Conditions associated with fatigue or reduced cellular energy production

## Cardiovascular function and healthy aging

Carnitine supplementation may be beneficial for cardiovascular function. Cardiovascular disease is the leading cause of death in those with type 2 diabetes, and carnitine has been shown to protect cardiac muscle cells from damage induced by oxidative stress, reduce formation of reactive oxygen species (ROS), and upregulate antioxidant signaling in hyperglycemic conditions in vitro, leading researchers to propose L-carnitine “as an adjuvant in diabetic cardiac regenerative medicine.”<sup>8</sup> L-carnitine supplementation has been shown to improve cardiac function and symptoms in subjects with mild diastolic heart failure.<sup>9</sup> In a crossover study of subjects with stable angina, the mean work load and watts to onset of angina during a cycloergometer test were increased during carnitine supplementation compared to placebo and 22 percent of the subjects became free of angina during the carnitine phase.<sup>10</sup> Similar beneficial impact of carnitine was seen in subjects with exercise-induced stable angina, with some subjects improving their NYHA classification and reducing need for cardioactive medication.<sup>11</sup> Human and animal research indicate L-carnitine may be especially helpful for ischemic conditions.<sup>12,13</sup>

Numerous studies have shown carnitine to be supportive for reducing muscle wasting, favorably affecting nitrogen balance and improving frailty in older individuals and those with muscle wasting illnesses.<sup>14,15</sup> In elderly subjects, carnitine supplementation has been shown to increase total muscle mass and decrease fat mass, reduce physical and mental fatigue, and improve scores on the mini-mental state exam (MMSE).<sup>16,17</sup> In elderly subjects with rapid muscle fatigue, compared to placebo, carnitine supplementation resulted in significantly increased muscle mass and reduced fat mass, decreased triglycerides and apoB, with 40% and 45% decreases in physical and mental fatigue, respectively.<sup>18</sup>

## D-Ribose

D-ribose is a 5-carbon monosaccharide essential for biological function and energy generation. Ribose is needed to synthesize adenine nucleotides which are the backbone of DNA, RNA, certain vitamins and amino acids. Ribose is the starting point for synthesizing ATP, which makes it a perfect partner for L-carnitine in supporting sustained energy levels and healthy metabolic function.<sup>19</sup> Supplementation with D-ribose in subjects with chronic fatigue syndrome or fibromyalgia resulted in significant improvements in energy, sleep, pain intensity, mental clarity and wellbeing.<sup>20</sup> Additionally, like L-carnitine, D-ribose may be particularly helpful for individuals with ischemic cardiovascular disease and has also been shown to benefit those with congestive heart failure, including improving exercise tolerance and ventilatory status at anaerobic threshold in patients with heart failure (NYHA class III-IV).<sup>21-26</sup> Fatty acids are the preferred fuel for cardiac muscle, so pairing L-carnitine with D-ribose may be especially useful for supporting adequate cardiac cellular energy.

## Pantothenic acid

Pantothenic acid (vitamin B5) is included in this formula because it is required for the synthesis of coenzyme A (CoA), an essential factor in numerous life-sustaining biochemical reactions. CoA is required for enzymes that transport fatty acids across cell membranes as well as for the conversion of carbohydrates, fats and proteins into ATP. For these reasons, administering pantothenic acid along with carnitine may be beneficial for the purpose of facilitating fat burning and cellular energy synthesis. Frank deficiency in this nutrient is rare but subclinical insufficiency may result from long-term caloric restriction, which may be common among those desiring to lose weight and supplementation may be warranted in individuals with conditions associated with fatigue.

### Recommended Use

- As a dietary supplement, take 5 mL (approx. 1 teaspoon) per day, or as directed by your health care practitioner.

### Suggested Dosing Guidelines:

- L-carnitine is best taken on an empty stomach as it will not compete for absorption with other amino acids or peptides. When taken with meals, it will achieve a lower but more prolonged elevated plasma level. If sustained high blood concentrations are desired, carnitine should be taken multiple times per day in doses of 1-2 g (for example, first thing in the morning and approx. 2-3 hours after any meal or snack). It is not recommended to take late in the day due to its potentially energizing effect.

*For a list of references cited in this document, please visit:*

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