



**THE WORLD  
OF L-CARNITINE**

# L-Carnitine – The natural choice for functional foods

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Consumers today are well aware of the relationship between health, diet and fitness and a healthy lifestyle and healthy food are now recognised as a priority in most people's lives. The growth in sectors such as organic foods, vegetarianism, functional foods and dietary supplements clearly shows that the consumers' demand for healthy food is increasing. Growing consumer awareness of the benefits of an improved diet means for manufacturers that the ingredients used in functional foods must be chosen with safety, efficacy and quality in mind. L-CARNIPURE® L-Carnitine can be considered to be a winning ingredient, helping functional food manufacturers capitalise on a healthy, growing market.

## WHAT IS L-CARNITINE?

Carnitine, like many biologically active molecules, exists in two forms: L-Carnitine and D-Carnitine. These two forms or isomers are mirror images of each other. Only L-Carnitine is the naturally occurring and effective form. D-Carnitine does not occur in nature and is harmful to the human body in that it inhibits the utilisation of L-Carnitine.

L-Carnitine is a vitamin-like nutrient which is essential for the conversion from fat into energy. The primary role of L-Carnitine is to shuttle long chain fatty acids into the mitochondria, the "furnace of the cell". There, the fatty acids are oxidised and energy is produced. Another important function of L-Carnitine is the ability to shuttle

short chain fatty acids from inside the mitochondria to the cytosol, which is an essential detoxification step within metabolism. Furthermore, L-Carnitine has been shown to buffer the (bound Coenzyme A) : (free Coenzyme A)-ratio and remove excess concentrations of Acyl-Coenzyme A, thereby helping energy production to continue.

Small quantities of L-Carnitine are produced in the human body (approximately 20 mg/day), with highest concentrations occurring in the heart and skeletal muscle. For the major part, however, the daily L-Carnitine requirement is met by food intake (Table I). The average, non-vegetarian diet is estimated to provide 100-300 mg L-Carnitine/day, but varies greatly from country to country. Australia and New Zealand have an estimated intake of 290 mg L-Carnitine/person/day, USA approximately 225 mg, Europe 120 mg, whereas L-Carnitine consumption in Japan is only at around 72 mg/person/day.

**Table I**

Food of animal origin (uncooked)	L-Carnitine [mg/100 g]	Food of plant origin (uncooked)	L-Carnitine [mg/100 g]
Lamb	190	Mushroom	2.6
Beef	143	Carrot	0.4
Pork	25	Bread	0.4
Poultry	13	Rice	0.3
Fish	3-10	Banana	0.1
Egg	0.8	Tomato	0.1

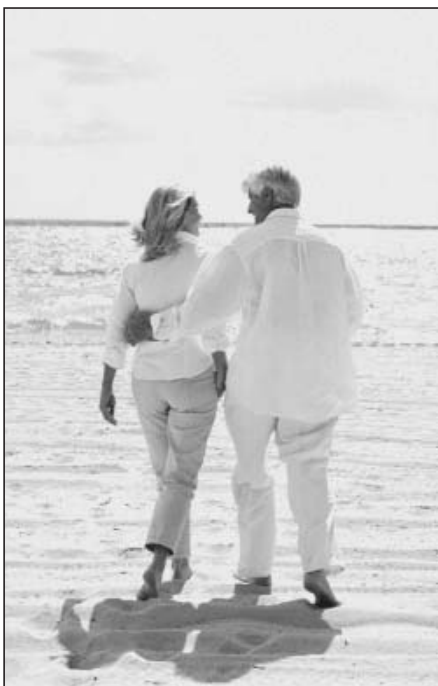
Plant foods contain only traces of L-Carnitine while foods of animal origin contain higher amounts of this nutrient



## BENEFICIAL ROLE OF SUPPLEMENTARY L-CARNITINE

Extensive clinical research has discovered that L-Carnitine has a beneficial role to play in a broad array of applications.

- It is widely accepted that L-Carnitine has significant **cardioprotective properties**. L-Carnitine supplements have a favourable effect on blood lipid levels, and have demonstrated to be helpful for people with angina, arrhythmias and heart failure.
- Supplementation with L-Carnitine prior to high intensity **exercise** is significantly effective in assisting recovery. Volek et al. (2002) observed a decrease in the



production of free radicals, less tissue damage and reduced muscle soreness after exercise and a better utilization of fat as an energy source during recovery.

- Studies also indicate that L-Carnitine is useful as part of a **weight management programme** when combined with exercise and calorie restriction.
- L-Carnitine is considered to be an **essential nutrient for infants** because, unlike adults, infants are unable to synthesize sufficient L-Carnitine in their bodies to meet their requirements. L-Carnitine is present in breast milk and for some years now, manufacturers of soy-based infant formula have been fortifying their products with L-Carnitine, which would otherwise be devoid of this conditionally essential nutrient.
- Various studies in elderly subjects show improved mental status and learning ability, improved immune function or an increase in muscle mass after supplementation with L-Carnitine. Thus, L-Carnitine can be regarded as the **ideal nutrient for a long life**, as it comprises all the benefits that seniors need to stay fit and healthy in both mind and body.

## QUALITY AND SAFETY OF L-CARNITINE

At Lonza, delivering safe, effective and the highest quality ingredients is a responsibility which is taken very seriously. Due to a unique and patented production process with an integrated biotransformation step, Lonza is the only L-Carnitine manufacturer able to supply 100% pure L-Carnitine without any harmful D-Carnitine, hence the brand name and sign of quality assurance, L-CARNIPURE®.

Although D-Carnitine or the racemic mixture DL-Carnitine is not allowed to be used in food products in most countries, depending on the

manufacturing process used to produce L-Carnitine, some D-Carnitine may still be found in L-Carnitine products. Supplementation with D-Carnitine, a competitive inhibitor of L-Carnitine, however, leads to a functionally



*Lonza's state-of-the-art, FDA registered and ISO 9002 certified L-Carnitine production facility*

relevant depletion of L-Carnitine in skeletal and cardiac muscle and must be avoided.

Lonza has been supplying L-CARNIPURE® L-Carnitine Crystalline and L-Carnitine L-Tartrate to the dietary supplement, pharmaceutical and infant formula industries globally for many years (Table II). More recently, an increasing number and variety of functional food products such as probiotic yoghurt drinks, confectionery, bread or sausages supplemented with L-CARNIPURE® L-Carnitine has entered the market.



*Lonza, the leading manufacturer and supplier of the bulk dietary supplement L-Carnitine, is the only supplier who can guarantee 100% pure, natural L-Carnitine – totally free from toxic D-Carnitine. L-CARNIPURE® and the L-CARNIPURE® logo are registered trademarks of Lonza and our assurance of outstanding quality*



## WIDE RANGE OF APPLICATIONS

The physical properties of L-CARNIPURE® L-Carnitine Crystalline and L-Carnitine L-Tartrate make these products manufacturer-friendly. As functional food ingredients, they can be used in any application where dietary enrichment is appropriate. Both products are bright white, heat stable, highly water soluble and form colourless solutions. L-Carnitine is inherently hygroscopic and therefore especially suited to liquid applications or applications where a low dose of L-Carnitine is required, e.g. infant formula. L-Carnitine L-Tartrate, on the other hand, is a non-hygroscopic salt of L-Carnitine and thus perfect to use in any solid or liquid application. Among all salt forms currently commercially available, L-Carnitine

L-Tartrate contains the highest concentration of L-Carnitine (68%).

Due to excellent handling properties and high stability under most processing conditions, L-Carnitine can be added to many different food product forms, including beverages, bars, cereals, biscuits, bread, effervescent tablets, dairy products, candies, chewing gum and chocolate. Baking trials with L-Carnitine have shown that this process has a negligible effect on L-Carnitine content, which allows addition of L-Carnitine during

production processes operating at high temperatures.

## LONZA – YOUR PARTNER IN FUNCTIONAL FOOD DEVELOPMENT

With global experience, Lonza's technical, research, sales and marketing staff is happy to work in partnership with customers and potential customers to ensure the successful development and production of L-Carnitine-enriched functional foods. For further information, please visit our website [www.carnitine.com](http://www.carnitine.com).

**Table II – L-CARNIPURE®: Product specific properties**

L-CARNIPURE® L-Carnitine Crystalline	L-CARNIPURE® L-Carnitine L-Tartrate
100% pure L-Carnitine	Stable salt containing approximately 68% L-Carnitine, 32% natural L-tartaric acid
White, crystalline powder	White, crystalline powder
Highly water soluble, forms colorless solutions	Highly water soluble, forms colorless solutions
Odorless	Odorless, pleasant fruity flavor
Heat stable up to 120°C	Heat stable up to 120°C
Hygroscopic - especially suitable for liquid applications	Non-hygroscopic – suitable for all solid and liquid applications
Generally Recognized As Safe (GRAS)	Generally Recognized As Safe (GRAS)
Excellent safety profile – LD <sub>50</sub> could not be determined	Excellent safety profile – LD <sub>50</sub> could not be determined
Meets specifications of Food Chemicals Codex (F.C.C.) and United States Pharmacopoeia (U.S.P.)	L-Carnitine and L-Tartaric acid used to produce L-Carnitine L-Tartrate meet specifications of F.C.C. and U.S.P.
	U.S. patent 5,073,376 and other international patents
Free of animal products	Free of animal products
Free of genetically modified organisms (GMOs)	Free of genetically modified organisms (GMOs)