

L-Carnitine – the ideal supplement for vegetable-based products

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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.

Whereas the number of vegetarians (the majority being young females) has become static, the number of meat-reducers and red meat-avoiders is increasing. A report on the vegetarian food market shows continued growth in vegetarian food purchases, which does not only come from "true" vegetarians, but also from a higher number of meat-reducers and red meat-avoiders. Vegetable-based versions of meat and fish products, such as vegetable fingers and grills, as well as soy- and texturised vegetable protein based items and those made from the fermentation product Quorn have all grown steadily in popularity, becoming increasingly part of consumers' everyday food purchases. According to Taylor Nelson Sofres, the total vegetarian market in the UK was worth £583 million in 2003.

Nutritional risks associated with being a vegetarian

The rising awareness and uptake of vegetarianism as a method of addressing health related food scares and animal cruelty issues, plus the fact that broadening ranges of vegetarian products are bringing the sector into the mainstream market, have resulted in the need to look at the vegetarians' supply with certain nutrients. One nutrient

that is almost totally devoid in a vegetarian diet is L-Carnitine. L-Carnitine, the biologically effective isomer of Carnitine, plays a key role within several energy production pathways. It is essential for the transport of long-chain fatty acids across the inner mitochondrial membrane towards their oxidative fate inside the mitochondria and thus ultimately energy generation.



Although a meat-reduced or vegetarian diet can be a healthy choice and has various benefits, there are certain nutritional risks associated with being a vegetarian. Dietary supplementation from non-animal based sources is required to meet nutritional guidelines. Animal products, such as lamb, beef and pork, contain the highest amounts of dietary L-Carnitine. Lower levels of L-Carnitine are found in dairy products. In many plant foods, L-Carnitine levels cannot even be detected. Strict vegetarians therefore have negligible sources for this nutrient. Table 1 shows data on the L-Carnitine content of various foods.

Food of animal origin (uncooked)	L-Carnitine [mg/100g]	Food of plant origin (uncooked)	L-Carnitine [mg/100g]
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

Table 1: Plant foods contain only traces of L-Carnitine while foods of animal origin contain higher amounts of this nutrient.

The typical non-vegetarian, Western diet is estimated to provide around 100-300 mg L-Carnitine per day. In Europe, however, the average L-Carnitine intake has decreased by about 20% over the last decade, mainly as a result of a decrease in beef intake.

Ovo-lacto-vegetarians are estimated to have an intake of about 10-40



mg L-Carnitine per day. With a strict vegetarian diet, the total amount of ingested L-Carnitine is further reduced and was found to be around 1-4 mg/day. The consequences of impaired L-Carnitine ingestion upon vegetarian health and nutrition have received relatively little or no attention to date in man. This is surprising as the L-Carnitine requirements of the body are met almost exclusively from the consumption of meat, with limited de-novo synthesis. If intake of L-Carnitine is low, however, the body must almost entirely rely on the endogenous synthesis to meet the needs. A vegetarian diet is frequently low in some of the nutrients that are essential for L-Carnitine biosynthesis in the body, such as the amino acids lysine and methionine as well as iron.

Vegetarians have lower L-Carnitine plasma levels

Indeed, humans ingesting a lacto-ovo- or a strict vegetarian diet over years have shown to have decreased plasma L-Carnitine concentrations. In a study comparing several blood parameters of 46 lacto-ovo-vegetarians and 49 non-vegetarians, the lacto-ovo-vegetarians were found to have a favourable lipoprotein profile, but decreased total and free serum L-Carnitine concentrations. Serum L-Carnitine levels seem to be even more depressed in vegetarian children and infants who do not receive a dietary source of L-Carnitine. These differences are suggested to be due to relatively higher requirements for L-Carnitine because of growth and tissue distribution. When omnivorous college students were provided with an L-Carnitine free enteral diet, plasma total L-Carnitine declined by 42% within the first 7 days.

L-Carnitine and exercise

High performance athletes such as triathletes have been shown to have lower than normal plasma levels of L-Carnitine, even when maintaining an omnivorous diet. This has been attributed to a higher excretion of L-Carnitine via the kidneys after severe exercise. Due to the high fat and protein content of meat, however, many athletes wishing to consume a carbohydrate-rich diet often omit meat and may be "silent" vegetarians. Researchers observed that those triathletes who were on a predominantly vegetarian diet had the lowest levels. Supplementation of 30mg L-Carnitine/kg body weight during 6 weeks could increase total L-Carnitine from 27µmol/L to 100µmol/L and free L-Carnitine from 10µmol/L to 85µmol/L. This considerable increase also improved the ratio of Acyl-L-Carnitine to total L-Carnitine, which is a mean to express the supply of functionally active L-Carnitine.

Vegetarians and anyone following a meat-reduced diet can benefit from additional L-Carnitine, even if there is not a real clinical deficiency. After heavy exercise, vegetarians may get a functional L-Carnitine deficiency. Such people can include L-Carnitine in their daily diet in the form of L-Carnitine enriched conventional foods or dietary supplements to optimize performance, delay the onset of fatigue and enhance recovery processes.



L-CARNIPURE®

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

"Twenty-two years of tofu is a lot of time."
Paul Obis, founder of *Vegetarian Times*, on why he started eating meat again



In Summary

Vegetarians have a significantly reduced dietary intake of L-Carnitine and may be missing out on the tremendous health benefits of this nutrient. Consequently, in the US L-Carnitine has been granted GRAS status for foods that mimic L-Carnitine-rich foods but are low in L-Carnitine, e.g. soy burgers, soy hot dogs and soy cheese. Although L-Carnitine is naturally present in meat products, Lonza's L-Carnitine is not derived from animal sources and is synthesised by a patented multi-step biological production process. The time has come for vegetarian food manufacturers to ensure that their consumers are getting both what they want and what they need nutritionally – the time has come to fortify with L-Carnitine.

For further information, please visit www.carnitine.com.

About the Author:

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