

Carnipure™ Focus

Male Fertility

Lonza

Introduction

Infertility is more common than generally thought¹. Defined as the inability of a couple to achieve pregnancy after one year of unprotected intercourse², infertility affects about 10–15% of couples around the world who are attempting their first pregnancy³. In the USA, this amounts to 6.1 million couples yearly^{4,5}.

In rough terms, about one-third of infertility cases can be attributed to male factors, and about one-third to factors that affect women. For the remaining one-third of infertile couples, infertility is caused by a combination of problems in both partners or, in about 20 per-cent of cases, is unexplained (Figure 1)^{6,7}.

Supplementation with Carnipure™ can provide valuable support for the male reproductive system. Clinical research over the last few decades has reported that L-Carnitine is found in high concentrations in sperm. Furthermore, L-Carnitine plays a part in sperm energy metabolism and most importantly, may support sperm quality.

What is Carnipure™?

Carnipure™ is a special grade of L-Carnitine, manufactured by the Swiss life-science company Lonza. Thanks to a unique production process based on fermentation, Lonza is the only L-Carnitine manufacturer capable of producing L-Carnitine in the same way as nature. Products carrying the Carnipure™ quality seal on the packaging show the consumer that they contain pure Lonza L-Carnitine.



Carnipure™ offers purest L-Carnitine and is a trademark of Lonza Ltd, Switzerland.

What is L-Carnitine?

L-Carnitine is a natural substance that can be found in human tissues. The body can synthesize this nutrient⁸, but the major part comes from meat intake⁹. Foods of plant origin contain very little, if any, L-Carnitine. Due to a decrease in meat consumption, the average dietary L-Carnitine intake has decreased considerably over the last decade.



Male reproductive system

To help in understanding the role of L-Carnitine, here is a very simplified look at how the male reproductive system operates. The organs of the male reproductive system include:

- the testicles which are responsible for producing sperm, a process that takes 65–75 days in humans
- a system of ducts or tubes (epididymis, vas deferens, ejaculatory ducts and urethra) which transport and store sperm, assist in their maturation and convey them to the exterior
- accessory sex glands (seminal vesicles, prostate and bulbo-urethral gland). The prostate gland and seminal vesicles secrete fluids which make up about 85% of the volume of semen
- several supporting structures, including the scrotum and the penis

Semen is a mixture of sperm and seminal fluid, a liquid that consists of the secretions of the testicles and the accessory sex glands. Seminal fluid provides sperm with a transportation medium and nutrients¹⁰.

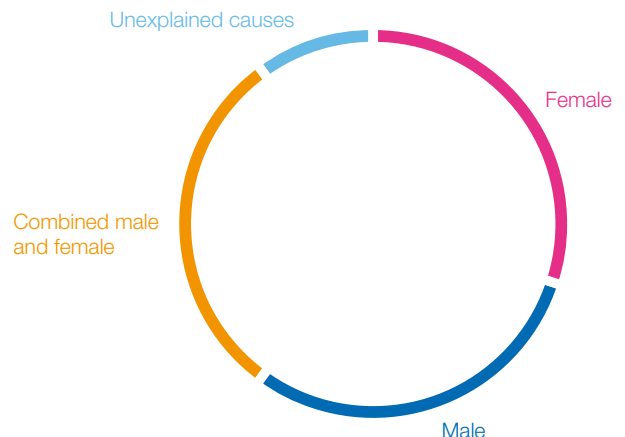


Figure 1: Contribution of male- and female related factors to overall infertility levels^{6,7}

Semen analysis and sperm quality

It is estimated that 40% of human infertility is entirely or partly related to deficiencies in sperm quality¹¹, or more specifically to problems with the number, motility or shape of sperm. Semen analysis gives an indication as to the type and severity of the issue¹² and is considered an indirect assessment of fertility potential¹. A number of measurements are made during semen analysis and contribute to semen and sperm quality. These include:

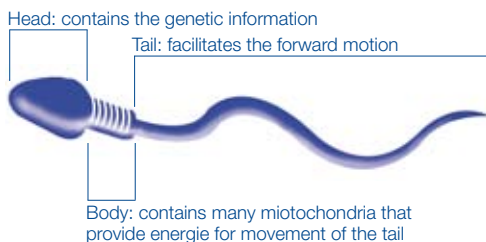
Sperm concentration – the number of sperm that is found in each milliliter of semen¹²

Total sperm count – the total number of sperm present in the semen (semen volume multiplied by sperm concentration); this value accurately describes sperm production by the testicles¹³

Sperm motility – the percentage of sperm that are moving; this is vitally important as the sperm must be motile to “swim” up the vagina¹²

Rapid linear progression – an indication of the percentage of sperm that display rapid, forward movement; these sperm are thought to be most likely to “swim” ahead, reach the egg and cause fertilization¹¹

Morphology – the % of sperm with a normal shape¹²



Microscopic view of sperm

High levels of L-Carnitine in sperm

The male genital tract contains several compartments that maintain the highest free L-Carnitine concentrations in the body: epididymal tissue, seminal plasma and spermatozoa¹⁴. To date, studies in rodents and humans suggest that sperm count, motility and maturation are related to epididymal free L-Carnitine concentrations¹⁵. Spermatozoa produced in the testis travel along the epididymis to the vas deferens, and acquire motility and fertilizing ability during their passage through the epididymis^{10, 16}.

Free L-Carnitine is actively transported from the circulating blood into the fluid in the interior of the epididymis via the high-affinity L-Carnitine transporter OCTN2¹⁶⁻¹⁸, as well as via a testis-specific L-Carnitine transporter CT2¹⁹. The subsequent passive diffusion of free L-Carnitine from the epididymal fluid into sperm^{15, 16}, as they travel along the epididymis, results in a very high concentration of free L-Carnitine in the sperm, some of which is converted to Acetyl-

L-Carnitine (in mature sperm only). Worth noting is that the initiation of sperm motility occurs in parallel to the increase of free L-Carnitine inside the epididymis¹⁶. As sperm mature, the ability to take up L-Carnitine decreases and ejaculated sperm have a limited capacity to take up either L-Carnitine or Acetyl-L-Carnitine¹⁶. It is assumed that this property protects the sperm as they journey through the female reproductive tract and that the storage of free L-Carnitine and Acetyl-L-Carnitine within mature and ejaculated sperm may be a guarantee of sperm viability¹⁶.

L-Carnitine: Important for sperm energy metabolism

In the human body, L-Carnitine's primary function is to carry fatty acids into the mitochondria where they can be broken down with the ultimate production of energy²⁰. In healthy adults, Carnipure™ supplementation has been shown to stimulate *in vivo* long chain fatty acid metabolism^{21, 22}.

Sperm in the epididymis utilize fatty acids as their source of metabolic energy²³. One of the functions of L-Carnitine in sperm is regarded to carry fatty acids into the sperm mitochondria, thereby assisting with the production of energy^{14, 15}.

Secondly, free L-Carnitine reacts with excess acetyl CoA groups, generated by mature sperm during energy producing processes, thereby forming Acetyl-L-Carnitine. This buffering reaction removes elevated intracellular acetyl CoA levels and restores free CoA levels, thereby facilitating the continuation of energy production within the sperm. At the same time, the Acetyl-L-Carnitine, thus formed, serves as a readily available source of acetyl groups, i.e. energy, for the sperm^{16, 24}. Like all cells living under aerobic conditions, spermatozoa produce reactive oxygen species (ROS), mostly originating from normal metabolic activity. Oxidative stress though has been shown to be a major cause of male infertility. L-Carnitine can also be regarded as an antioxidant, decreasing ROS in spermatozoa^{14, 25, 26}.

L-Carnitine: Relationship with sperm motility and count

Clinical research has found that the concentration of free L-Carnitine in semen is positively related to sperm count, sperm motility and the number of motile sperm/mL semen in infertile men with varying degrees of sperm count and motility²⁷. In a similar population, the concentration of total L-Carnitine in sperm was reported as being directly related to sperm motility, while the concentration of total L-Carnitine in seminal plasma was related to sperm count²⁸.

Thus L-Carnitine can also be regarded as a diagnostic tool and a marker to measure sperm quality and epididymal function^{26, 29-32}.

Effects of Carnipure™ supplementation on sperm

An emerging body of scientific evidence shows L-Carnitine's ability to help support male reproductive health³³⁻⁴⁴. In infertile men, the concentrations of L-Carnitine in seminal plasma are significantly reduced as compared to healthy men^{29, 45, 46}. Generally, L-Carnitine supplementation is associated with significant increases in sperm concentration and count, % motile sperm and the % sperm with rapid linear progression.

Since it is well accepted that reproductive efficiency is highest for individuals with good nutritional status and health⁴⁷, and since this supplement has a role in supporting sperm health, supplementation with Carnipure™ may be recommended to males interested in supporting their reproductive health.

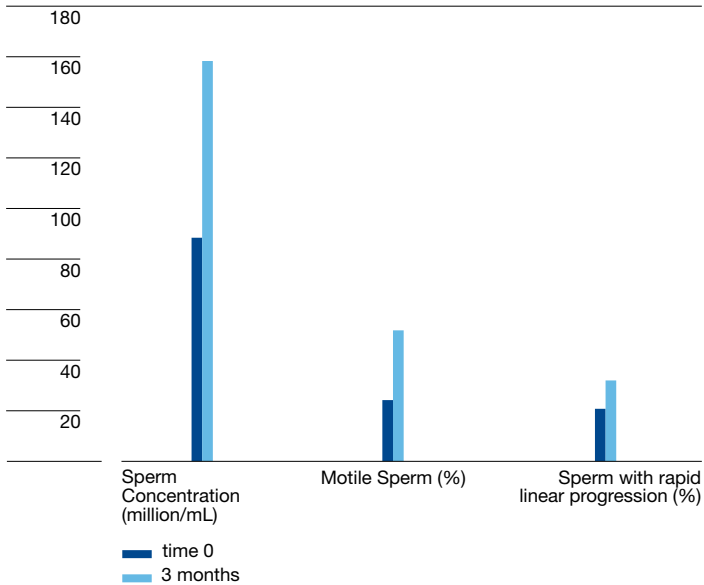


Figure 2: Semen analysis in infertile men before and after L-Carnitine supplementation³³

And so to conclude

L-Carnitine plays an important role in male reproductive health, mainly due to increased mitochondrial fatty acid oxidation, which results in improvement in motility of epididymal sperm. Clinical studies suggest that L-Carnitine supplementation over a period of 3 to 6 months can positively affect sperm concentration, sperm count, the percentage of motile sperm and the percentage of sperm with rapid progression. Carnipure™ supplementation should be considered by all men interested in supporting their reproductive system.

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Note: This document is an overview of published scientific information on L-Carnitine and published scientific information on clinical and nutritional trials with L-Carnitine and its derivatives. No claims are made herein for any particular consumer product, nor can these statements be used on such consumer products. The recommended use for Carnipure™ is as a nutrient or dietary supplement.

The statements in this document have not been evaluated by any Food and Drug Administration. Lonza's Carnipure™ is not intended to diagnose, treat, cure or prevent any disease.

No statement is intended or should be construed as a recommendation to infringe any existing patent. The information contained herein is believed to be correct and corresponds to the latest state of scientific and technical knowledge.



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