

# Carnipure® Focus

## Male Fertility



Infertility is more common than generally assumed. Defined as the inability of a couple to conceive after one year of unprotected intercourse, infertility affects about 10–15 % of couples around the world who are attempting their first pregnancy, with approximately 35 % of cases due to female factors alone, 30 % due to male factors alone, 20 % due to a combination of female and male factors, and 15 % due to unexplained causes<sup>1-3</sup>. In the US, this amounts to 7.3 million couples yearly, and in American men, this risk correlates to approximately 1 in 25<sup>1,4</sup>. 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 where it plays a part in sperm energy metabolism. Most importantly, L-carnitine may support sperm quality

### What is Carnipure®?

Carnipure® is high quality L-carnitine manufactured by the Swiss life-science company Lonza. Products displaying the Carnipure® quality seal on the packaging show the consumer that they contain high quality L-carnitine from Lonza.



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### What is L-carnitine?

L-carnitine is a natural substance that can be found in human tissues. The body is able to synthesize this nutrient, but the major part comes from dietary intake, mainly from meat<sup>5,6</sup>. Foods of plant origin contain very little, if any, L-carnitine. Due to a decrease in meat consumption over the last decade, the average dietary L-carnitine intake has decreased considerably. L-carnitine is biologically important for mitochondrial beta-oxidation of long-chain fatty acids and thus for energy generation in the form of ATP.

## Semen Analysis and Sperm Quality

It is estimated that 40 – 50 % of human infertility is entirely or partly related to deficiencies in sperm quality or, more specifically, to problems with the number, motility, or shape of sperm <sup>7</sup>. Semen analysis gives an indication of the type and severity of the issue and is considered to be an indirect assessment of fertility potential. A number of measurements taken during semen analysis help to determine semen and sperm quality <sup>8</sup>. These include:

- Sperm concentration – the number of sperm per milliliter of semen
- 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 testicles <sup>9</sup>
- Sperm motility – the percentage of sperm that are moving; this is vitally important as the sperm must be motile to travel through the vagina
- 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 fertilization <sup>7</sup>
- Morphology – the percentage of sperm with a normal shape

## High Levels of L-carnitine in Sperm

Three compartments of the male genital tract – epididymal tissue, seminal plasma, and spermatozoa – maintain the highest free L-carnitine concentrations in the body <sup>10</sup>. Both animal and human studies suggest that sperm count, motility, and maturation are related to epididymal free L-carnitine concentrations <sup>11</sup>. Spermatozoa produced in the testis travel along the epididymis to the vas deferens, acquiring motility and fertilizing ability during their passage through the epididymis <sup>12,13</sup>. 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 OCTN2 as well as via the testis-specific substrate-selective L-carnitine transporter CT2 <sup>13–16</sup>. The subsequent passive diffusion of free L-carnitine from the epididymal fluid into sperm travelling 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) <sup>11,13</sup>. Worth noting is that the initiation of sperm motility occurs in parallel to the increase of free L-carnitine inside the epididymis <sup>13</sup>.

## Male Reproductive System <sup>12</sup>

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 eventually are responsible for ejaculation.
- Accessory sex glands (seminal vesicles, prostate, and bulbourethral gland). The prostate gland and seminal vesicles secrete fluids which make up about 85 % of semen volume.
- 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 nutrients.

## 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 energy <sup>17</sup>. In healthy adults, Carnipure® supplementation has been shown to stimulate *in vivo* long-chain fatty acid metabolism <sup>18,19</sup>. Sperm in the epididymis utilize fatty acids as their source of metabolic energy <sup>20</sup>. One of the functions of L-carnitine in sperm is to carry fatty acids into the sperm mitochondria, thereby assisting with the production of energy <sup>10,11</sup>.

Secondly, free L-carnitine reacts with excess acetyl coenzyme A (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 formed acetyl-L-carnitine serves as a readily available source of acetyl groups, i.e. energy, for the sperm <sup>13,21</sup>.

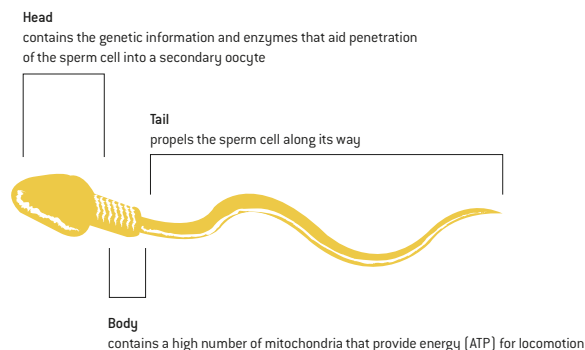


Fig.1  
A sperm cell <sup>12</sup>

## Antioxidant Properties of L-carnitine

Like all cells living under aerobic conditions, spermatozoa produce reactive oxygen species (ROS), mostly originating from normal metabolic activity. Oxidative stress, however, has been shown to be a major cause of male infertility. L-carnitine, which exerts antioxidant activity via increasing expression of antioxidant enzymes such as haeme oxygenase-1 and endothelial nitric oxide synthetase, can also be regarded as an antioxidant as it decreases ROS in spermatozoa<sup>10,22–25</sup>.

## L-carnitine: Diagnostic Tool for Sperm Quality and Gland Function

Clinical research shows 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 motility<sup>25–27</sup>. The concentration of total L-carnitine in sperm seems to be directly related to sperm motility, while the concentration of total L-carnitine in seminal plasma is related to sperm count<sup>28</sup>. Thus, L-carnitine can also be regarded as a diagnostic tool and a marker to measure sperm quality<sup>23,29–33</sup>. Free L-carnitine actually serves as a marker for clinically evaluating the secretory capacity and thus the gland function of the epididymis<sup>8</sup>. Epididymal plasma contains the highest concentrations of L-carnitine found in the human body – 2000 times higher than in circulating blood levels<sup>16</sup>.

## Effects of Carnipure® Supplementation on Sperm

An emerging body of scientific evidence shows L-carnitine's ability to help support male reproductive health<sup>34–47</sup>. In infertile men, the concentrations of L-carnitine in seminal plasma are significantly reduced as compared to healthy men<sup>29,48,49</sup>. Dosages of L-carnitine between 1-4 g/day is effective<sup>37,38,41,46</sup>. Generally, L-carnitine supplementation is associated with significant increases in sperm concentration and count, percent motile sperm, and percent sperm with rapid linear progression (Fig. 2). Since it is widely accepted that reproductive efficiency is highest for individuals with good nutritional status and health, and since this supplement has a role in supporting sperm health, supplementation with Carnipure® may be recommended to males interested in promoting their reproductive health<sup>50</sup>.

## Conclusion

L-carnitine may play an important role in male reproductive health, mainly due to increased mitochondrial fatty acid oxidation, which results in improved 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 men interested in supporting their reproductive system.

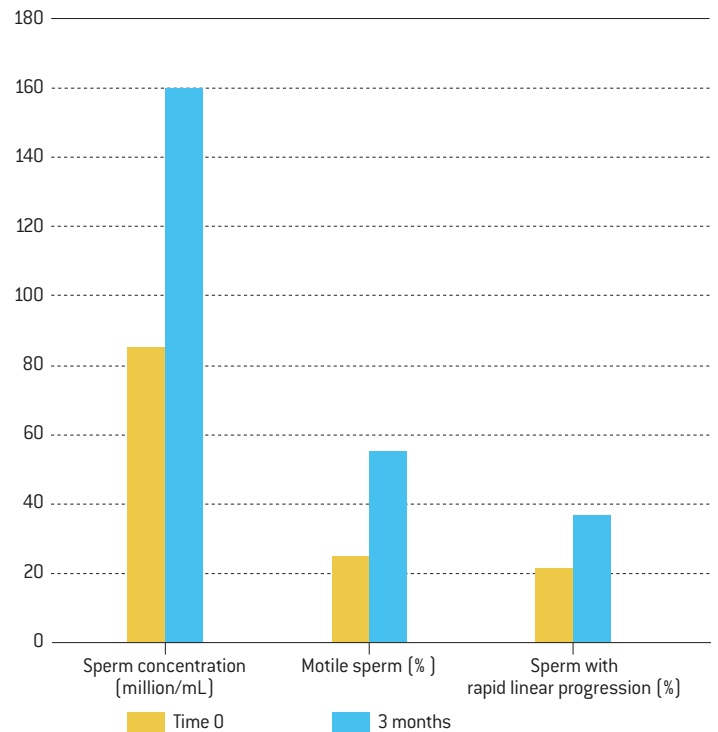


Fig. 2  
Semen analysis in infertile men before and after L-carnitine supplementation<sup>40</sup>



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