



# L-Arginine as a Nutritional Supplement in Physical Exercise



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## Introduction

L-arginine is an amino acid that is considered essential for the proteogenesis. It is located naturally in the proteins that make up our diet. It is abundant in seafood, watermelon, nuts, seeds, seaweed, meat, fish, and concentrated rice and soy proteins Bescós, Sureda, Tur, & Pons [1]. As described King, Mainous & Geesey [2], the daily average intake of arginine is 4.40g in the American population, depending also on gender, age, exercise level or ethnicity. Endogenous generation of L-arginine occurs mainly in the kidney from L-citrulline Ratner & Petrack [3]. It is the main precursor of nitric oxide (NO) that exists in the human body. This molecule is generated in the presence of oxygen and by the action of the enzyme nitric oxide synthase (NOS), of which three isoforms are known: neuronal (nNOS), inducible (iNOS) and endothelial (eNOS) Moncada & Higgs [4]. These enzymes are saturated with the concentration of 3 $\mu$ mol/l, which is the normal concentration in a healthy subject Bode-Böger et al. [5].

In relation to physiological adaptations in response to exercise, the action of NO is of the utmost importance, producing an increase in blood flow to the muscles and modulating muscle contraction and glucose uptake Glenn K McConell et al. [6]. It also participates in the control of cellular breathing through interactions with the enzymes of the mitochondrial respiratory chain and may have an antioxidant function in certain situations Brüne et al. [7]. In relation to muscle function, l-arginine allows the maintenance of a good function; nevertheless, there is no anabolic relationship metabolically proven between arginine and increase of muscular mass Paddon-Jones, Børsheim & Wolfe [8].

## Supplementation with l-arginine in sports performance

There are two ways of providing arginine supplementation: either orally or intravenously. The doses administered are also very variable and no adequate amount for the performance has been determined, which makes the studies included in this review very heterogeneous and therefore, not very comparable in terms of results.

## Oral supplementation of L-arginine as a single supplement

When assessing supplementation with L-arginine as a single supplement, it is observed that it has no effects on maximum and average aerobic power. In a study by Liu et al. [9] where 6g of L-arginine were provided during 3 days, there were no significant differences in maximal and average power in a cycle ergometer stress test performed on the third day of supplementation. In addition, no significant differences in plasma lactate concentration, ammonia, nitrate and nitrite concentrations between groups was observed. These results obtained are consistent with the results of Bailey et al. [10] that did not find any significant differences in lactate concentration in plasma when administering a supplement containing 6g of L-arginine 1 hour before a series of moderate to severe exercise intensity performing sets on cycle Ergometer for 3 days. However, there were significant differences in plasma nitrite concentration. On the other hand, a supplementation of 10g of L-arginine has no effect on the physiological and thermoregulatory response of basal metabolism, exercise and recovery in heat situation Tyler, et al. [11].

In strength training, L-arginine intake of .075g/kg of body weight prior to performing strength training did not seem to significantly change the levels of Growth Hormone (GH), ghrelin and Insuline Growth Factor  $\alpha$  (IGF1 $\alpha$ ). However, there have been significant decreases in the levels of somatostatin (GHIH) and cortisol Forbes et al. [12], Vieira et al. [13]. Therefore, it has been shown that the dosage used in the different studies does not directly affect the performance, but there have been changes at the physiological and endocrine level, so it would be valuable to establish other delivery guidelines in order to check if these changes can affect performance.

### **L-arginine combined with other supplements**

Intake of L-arginine in combination with L-ornithine in a 1:1 ratio seems to significantly improve strength and lean mass, compared with placebo groups Álvares T et al. [14]. If the amount of L-arginine increases to 10g in addition to 70g of carbohydrates (CHO), and is compared to the consumption of only 70g of CHO, it is observed that there are no significant differences in glucose and insulin concentrations in plasma after ingestion, when this ingestion is performed 30 minutes after different exercise protocols Robinson, Sewell & Greenhaff [15].

In endurance athletes and fighting sports, the combination of 0.17g/kg of branched amino acids, 0.05g/kg of L-arginine and other 0.05g/kg of L-citrulline, improves performance in competitions in consecutive days, due to the reduction of central fatigue and greater brain activation, as well as prevention of high ammonium levels through the production of urea Chen et al. [16], Cheng et al. [17]. Therefore, L-arginine does seem to improve sports performance when combined with other supplements.

### **Negative effects**

In relation to the negative effects, research seems to establish that supplementation with L-arginine has almost no negative effects on health. It seems that overcoming doses such as 13g of L-arginine administered intravenously after a night fast, where it was intended to measure concentrations of GH at different doses, can lead to a saturation of the organism Collier et al. [18]. Moreover, an excess of L-arginine (above 30g) could cause nausea, vomiting and diarrhea. It is unsure whether in healthy and athletic population scientific evidence exists of performance improvement associated with the consumption of L-arginine as supplement Paddon-Jones et al. [8].

### **Conclusion**

Considering all the studies evaluated, it is difficult to obtain consistent conclusions. The use of L-arginine as an effective ergogenic aid for increase sports performance seems to have potential, but a more comprehensive and monitored study is needed to clarify how L-arginine affects and what implications it has on exercise metabolism, although it is true that the combination of 0.05g/kg of L-arginine with ornithine, L-citrulline or branched-chain amino acids seems to have more relevance than when used alone in fighting and endurance sports.

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