

Creatine Monohydrate

Introduction

Creatine's safety and ability to increase power output and exercise performance is backed by strong evidence (1). An attribute less commonly spoken of however, is creatine's ability to boost brain function. Preliminary research shows that creatine supplementation improves recognition memory and reduces mental fatigue (3). Further, creatine administration supports short term memory and intellectual reasoning (2). One study in Australia showed that creatine supplementation for six weeks improved measures of memory and intellect (5). Let's discuss what makes creatine such an essential ingredient to your daily supplement stack.

What is Creatine?

Creatinine is an amino acid which is primarily synthesized in the liver and stored in skeletal muscle. The enzyme glycine transaminidase transfers an amidine group from arginine to glycine, to form guanidinoacetic acid. Guanidinoacetic acid is then methylated by the enzyme guanidinoacetate methyltransferase to form creatine (4). Aside from being endogenously synthesized, creatine can be found in many food sources such as beef, poultry, and fish.

About 90-95% of creatine is stored in skeletal muscle, with the remaining 5-10% subsisting in the brain, kidneys, liver, and testes (7). In short, creatine promotes the production of adenosine triphosphate (ATP), hence giving us more energy, and increasing our capacity for mental and physical work. So how does Creatine do this exactly?

Creatine Mechanisms & Benefits

After creatine is synthesized in the liver, it travels through the bloodstream to reach target tissues such as skeletal muscle, the heart, or the brain. There, creatine is phosphorylated in the mitochondria via the enzyme creatine kinase to yield creatine-phosphate (6). Creatine-phosphate donates its phosphate group to adenosine diphosphate (ADP) to form adenosine triphosphate, commonly known as ATP. ATP is the major stored form of energy in the human body. When ATP is depleted during episodes of intense exercise or thinking, whether it be in the muscles, brain, heart, or other tissues, creatine-phosphate helps to pick up the slack, and forge more ATP. Hence, simply providing you with more physical and mental energy.

How Does Creatine Promote Muscle Growth?

As an osmolyte, creatine supports cell hydration and reduces skeletal muscle inflammation. Nuclear Factor of Activated T Cells 5 (NFAT5) is a transcription factor and is the central regulator of gene expression involved in the osmolyte pathway of skeletal muscle. The NFAT5 pathway plays an integral role in the differentiation of immature myoblasts into mature-multinucleate myotubes, hence stabilizing intracellular protein function and promoting muscle growth (15). When combined with strength training, creatine supplementation has been proven to increase the number of satellite cells and myonuclei in skeletal muscle fibers (16). Satellite cells are precursors to muscle cells and are responsible for the regenerative capacity of muscle tissue (17). Additionally, creatine supplementation has been shown to increase levels of IGF-1 in skeletal muscle, and to reduce muscle breakdown and levels of myostatin. Myostatin

inhibits muscle cell proliferation, and so by inhibiting myostatin, creatine helps to promote muscle growth (18, 19).

Food Sources

Herring, beef patties, steak, salmon, beef burger, pork, mutton, venison, blood sausage, dry cured ham, lamb, chicken breast, rabbit, tuna, cod, beef heart, ox heart, beef cheek, falun sausage, hot dogs, mortadella, sausage, bovine tongue, bacon, and milk (9). Since Creatine is made from the three amino acids: L-arginine, L-methionine, and Glycine; food sources of these three amino acids may also promote endogenous Creatine production.

Foods high in L-arginine:

Nuts such as almonds, Brazil nuts, cashews, hazelnuts, peanuts, pecans, and walnuts.

Seeds, especially pumpkin seeds, but also sesame, sunflower, and watermelon seeds.

Dairy products. Meat, especially white meat.

One turkey breast contains a whopping 16.21 grams of arginine.

Whole grains contain significant amounts of arginine as well (10).

Foods high in L-methionine:

Ground turkey boasts 1583 mg.

Chicken, beef, lamb, and veal also contain significant amounts of methionine.

Fish such as tuna, grouper, salmon, snapper, tilapia, and mahi mahi.

Lean pork chops, ribs.

Firm tofu and milk.

Foods high in glycine:

Legumes, seafood, dairy, meat, gelatin, bone broth, poultry skin, spinach, dried seaweed, watercress, asparagus, cabbage (11, 12).

Dosage Rationale

Although there are many forms of creatine out there, we prefer creatine monohydrate, since it has undergone more scientific research and has been better proven for efficacy relative to any other form of creatine (13). If you haven't taken creatine before, then creatine loading is often recommended to maximize creatine stores. The most up-to-date recommendation for loading creatine goes as follows: take 0.3 grams per kilogram (.14g/lb) of bodyweight per day for 5–7 days, then follow with at least 0.03 g/kg (.014g/lb) per day, either for three weeks (if cycling) or indefinitely (without any additional loading phases) (1). The classic loading recommendation, however, simply says to take 20-25 grams per day, splitting doses into 5-gram increments, for about one week. Either method of loading should sufficiently bolster creatine stores. Taking 3-5

grams of creatine monohydrate per day thereafter, or 14 milligrams per pound, should suffice to maintain ample skeletal muscle stores of creatine (14). Creatine is best taken before and/or after your workout and should also be taken on off days. If you have a sensitive stomach, then you can take it with food. Additionally, creatine is best taken with cold liquids to prevent partial degradation.

We opted for the lower end of the recommended daily maintenance dose in Super U, in part to avoid stomach upset, but majorly since our formula provides many other ingredients that act in synergy with creatine to enhance its effects. AstraGin for example, improves the absorption of creatine by 33%. This in effect translates to a dosage of around 4 grams, landing right in that sweet spot of the recommended 3-5 gram daily maintenance dose. This amount, along with your daily intake of foods that contain creatine or the aforementioned amino acids which support the endogenous production of creatine, should suffice to provide you with plenty of mental and physical energy.

Side Effects:

Creatine acts as an osmolyte in muscle cells, as it promotes the hydration of the cell via water influx (7). Hence, Creatine may cause temporary water retention. However, this side effect is quickly reversed when you stop taking creatine. Creatine is very safe yet may have deleterious effects in people who are being treated with diuretics for a kidney disorder (8). Additionally, people that take supplements which increase the risk for developing kidney damage should not take Creatine. Having said this, for all other subjects, research shows that Creatine supplementation does not cause kidney damage.

Our Sourcing

At Wend Wellness we use only fully natural ingredients in all our products. Our sourcing of Creatine monohydrate is no different, as we provide you with a non-GMO, vegan, gluten free, and pure form of the extract. All Wend Wellness supplement products are third party tested for purity and held to the highest standard of quality and efficacy.

*These statements have not been evaluated by the Food and Drug Administration. This product is not intended to diagnose, cure, or prevent any disease.

References

1. Examine.com. (2022, March 17). Creatine - health benefits, dosage, side effects. Examine.com. Retrieved March 29, 2022, from <https://examine.com/supplements/creatine/>
2. Avgerinos, K. I., Spyrou, N., Bougioukas, K. I., & Kapogiannis, D. (2018, July 15). Effects of creatine supplementation on cognitive function of healthy individuals: A systematic review of randomized controlled trials. *Experimental gerontology*. Retrieved March 29, 2022, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6093191/>
3. The Royal Society. "Boost Your Brain Power: Creatine, A Compound Found In Muscle Tissue, Found To Improve Working Memory And General Intelligence." *ScienceDaily*. ScienceDaily, 13 August 2003. <www.sciencedaily.com/releases/2003/08/030813070944.htm>.

4. Google. (n.d.). What is creatine? Google. Retrieved March 30, 2022, from <https://www.google.com/amp/s/www.news-medical.net/amp/health/What-is-Creatine.aspx>
5. Boyles, S. (2003, August 13). Creatine may boost brain performance. WebMD. Retrieved March 30, 2022, from <https://www.webmd.com/alzheimers/news/20030813/creatine-may-boost-brain-performance>
6. Creatine. Creatine - an overview | ScienceDirect Topics. (n.d.). Retrieved March 30, 2022, from <https://www.sciencedirect.com/topics/nursing-and-health-professions/creatine>
7. Alfieri, R. R., Bonelli, M. A., Cavazzoni, A., Brigotti, M., Fumarola, C., Sestili, P., Mozzoni, P., De Palma, G., Mutti, A., Carnicelli, D., Vacondio, F., Silva, C., Borghetti, A. F., Wheeler, K. P., & Petronini, P. G. (2006, October 15). Creatine as a compatible osmolyte in muscle cells exposed to hypertonic stress. *The Journal of physiology*. Retrieved March 30, 2022, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1890352/>
8. Creatine. Mount Sinai Health System. (n.d.). Retrieved March 30, 2022, from <https://www.mountsinai.org/health-library/supplement/creatine>
9. Mobin, A., & Mobin, A. (2020, August 30). 20 foods high in creatine: Natural sources of creatine for bodybuilding. *Best for Nutrition*. Retrieved March 30, 2022, from <https://bestfornutrition.com/foods-high-in-creatine/>
10. Whitbread, D. (2021, July 28). Top 10 foods highest in methionine. *myfooddata*. Retrieved April 2, 2022, from <https://www.myfooddata.com/articles/high-methionine-foods.php>
11. James Myhre & Dennis Sifris, M. D. (n.d.). Should I be taking a glycine supplement? *Verywell Health*. Retrieved April 2, 2022, from <https://www.verywellhealth.com/glycine-overview-4583816>
12. Admin, D. I. S. (2020, January 18). Foods high in glycine: Uses and benefits. *Dr. Ian Stern*. Retrieved April 2, 2022, from <https://drianstern.com/blogs/learn/foods-high-in-glycine>
13. Buford, T. W., Kreider, R. B., Stout, J. R., Greenwood, M., Campbell, B., Spano, M., Ziegenfuss, T., Lopez, H., Landis, J., & Antonio, J. (2007, August 30). International Society of Sports Nutrition Position Stand: Creatine Supplementation and Exercise. *Journal of the International Society of Sports Nutrition*. Retrieved April 2, 2022, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2048496/>
14. Walle, G. V. D. (2019, April 24). Can you take too much creatine? side effects and dosage. *Healthline*. Retrieved April 2, 2022, from <https://www.healthline.com/nutrition/too-much-creatine#:~:text=creatine%20is%20futile-,Taking%20too%20much%20creatine%20at%20one%20time%20can%20result%20in,to%20maintain%20optimal%20muscle%20stores.>
15. Paepe, B. D. (2023, January 17). Osmolytes as mediators of the muscle tissue's responses to inflammation: Emerging regulators of myositis with therapeutic potential. *European Medical Journal*. Retrieved February 25, 2023, from <https://www.emjreviews.com/rheumatology/article/osmolytes-as-mediators-of-the-muscle-tissues-responses-to-inflammation-emerging-regulators-of-myositis-with-therapeutic-potential/>

16. Olsen, S., Aagaard, P., Kadi, F., Tufekovic, G., Verney, J., Olesen, J. L., Suetta, C., & Kjaer, M. (2006, June 1). Creatine supplementation augments the increase in satellite cell and myonuclei number in human skeletal muscle induced by strength training. *The Journal of physiology*. Retrieved February 25, 2023, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1779717/>
17. Satellite cell. Physiopedia. (n.d.). Retrieved February 25, 2023, from https://www.physio-pedia.com/Satellite_Cell#:~:text=Satellite%20cells%20are%20situated%20between,of%20muscle%20tissue%20to%20regenerate.
18. Burke DG;Candow DG;Chilibeck PD;MacNeil LG;Roy BD;Tarnopolsky MA;Ziegenfuss T; (n.d.). Effect of creatine supplementation and resistance-exercise training on muscle insulin-like growth factor in young adults. *International journal of sport nutrition and exercise metabolism*. Retrieved February 25, 2023, from <https://pubmed.ncbi.nlm.nih.gov/18708688/#:~:text=These%20findings%20indicate%20that%20creatine,independent%20of%20habitual%20dietary%20routine.>
19. Mawer, R. (2019, December 11). 10 health and performance benefits of Creatine. Healthline. Retrieved February 25, 2023, from [https://www.healthline.com/nutrition/10-benefits-of-creatine#:~:text=Additionally%2C%20some%20research%20indicates%20that,build%20muscle%20faster%20\(%2018%20\).&text=increased%20muscle%20growth%20and%20size.](https://www.healthline.com/nutrition/10-benefits-of-creatine#:~:text=Additionally%2C%20some%20research%20indicates%20that,build%20muscle%20faster%20(%2018%20).&text=increased%20muscle%20growth%20and%20size.)