Universal TORRENT: Old-School Post-Workout Supplement Still Dominates

written by Mike Roberto | December 7, 2022

We love **Universal Nutrition** because their approach to formulating supplements is inspired by *old school* bodybuilding – the overwhelming majority of ingredients Universal uses are backed by hardcore research, every once in a while they give a wink and a nod to the finest bodybuilding traditions.

We're long overdue for giving one of the OG post-workout supplements – *Universal Torrent* – some much-needed love!

When PricePlow was founded in 2008, one of the main supplements we discussed for post-workout gains was one that still stands tall today – with a formula that seems to have *never* changed since its inception. It's time to give some love to the one and only:

Universal *Torrent*: The OG Creatine/Carbs/Protein Post-Workout Supplement

But one of the OG post-workout supplements that brought *real* science with *old school bodybuilding* credibility is **Universal Nutrition *Torrent***. This is one of the original *post-workout supplements* that combines everything we want at that time – protein, carbs, creatine, taurine, aminos, and more!

When in doubt as to what you should take post-workout, this is a go-to formula you can *always* rely on – especially if there's no food around.

Before we talk about this awesome formula, let's first check the PricePlow news and deals:

Universal Torrent – Deals and Price Drop Alerts

Get Price Alerts

Get Torrent Price AlertsGet Universal alertsGet Post Workout Supplements price drops

☐ Also get hot deal alerts

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Torrent Macronutrients / Nutrition Facts

In a single *3-heaping-scoop serving* of **Torrent** from **Universal Nutrition**, you get the following:

Supplement Facts

Serving Size 3 Heaping Scoops (99g)

Amount Per Serving		%DV
Calories	290	
Calories from Fat	15	
Total Fat	1.5g	2%*
Saturated Fat	1g	5%*
Cholesterol	50mg	17%
Total Carbohydrate	50g	17%*
Sugars	25g	**
Protein	20g	40%
Calcium	115mg	12%
Magnesium	39mg	10%
Sodium	130mg	5%*
Potassium	175mg	5%
Torrent Proprietary Blend	18000mg	

Amount Per Serving		%DV
Anti-Catabolic Leucine Complex	8000mg	
L-Leucine		**
Leucine Alpha Ketoglutarate (AKG)		**
Leucine Ethyl Ester		**
N-Acetyl Leucine		**
Volubolic Amino Blend	7000mg	
Taurine		**
Glutamine		**
L-Phenylalanine		**
Citrulline Malate		**
Creabolic Complex	3000mg	
Creatine Monohydrate		**
Magnesium Creatine Chelate		**
Creatine Gluconate		**

* Percent Daily Value based on a 2000 calorie diet. ** Daily Value (DV) not established.

OTHER INGREDIENTS: Osmosulin Matrix (D-glucose, waxy maize, maltodextrin), protein blend [whey protein concentrate (providing di-, tri-, oligo- and polypeptides), whey protein hydrolysate], malic acid, natural and artificial cherry and berry flavors, citric acid, lecithin, sodium chloride, Red #40 Lake, dimagnesium phosphate, sucralose, acesulfame potassium, potassium phosphate, and FD&C Blue #1. Contains: Milk, Soy. Made in a GMP facility on equipment that processes milk, soy, egg, peanuts, tree nuts, fish, shellfish, and wheat.

- **Calories: 290**
- **Protein: 20 grams**
- **Fat: 1.5 grams**
- **Carbohydrates: 50 grams**
  - **Sugar: 25 grams**

Universal Torrent Ingredients

Where do those calories come from? Included are the carb and protein blends – but there’s far more than that!

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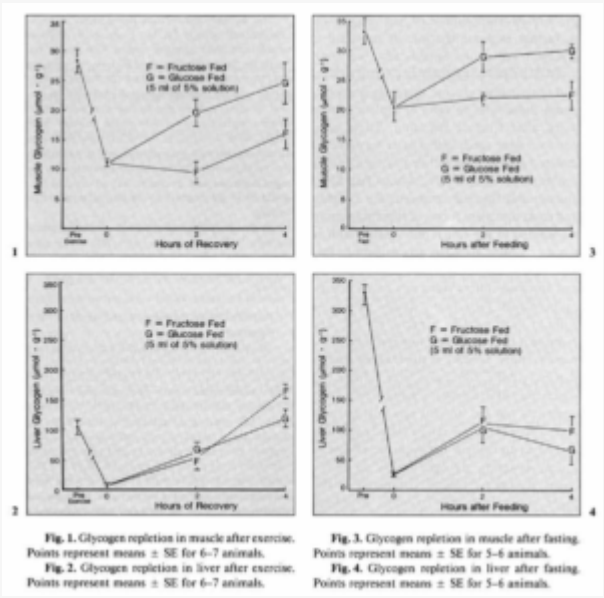
- **Osmosulin Matrix & Protein Blend – 50 grams CHO and 20 grams protein**
    - Torrent uses a blend of **D-Glucose**, **Waxy Maize**, and **Maltodextrin** to boost the caloric intake and drive insulin response.
        - **D-Glucose** is also known as *dextrose* and is a simple carbohydrate in the same structure that travels in our bloodstream, requiring very little digestive processing.
          A study showed that dextrose is superior to loading *muscle tissue* compared to *fructose*, which loads in the liver.[1] This is the *sugar* on the label, and as you can see, it’s 25 grams – half of our carbohydrate load.
        - **Waxy Maize** is a starch that comes from a variety of corn with *high amylopectin* and low *amylose* content.[2,3] It’s easily-digestible, thanks to these attributes – amylopectin is easily broken down, while amylose is a type of long-chain carbohydrate that’s not.
          Waxy Maize has a low glycemic index, allowing the carbs to be bumped up *without* too great of a blood sugar spike.[4]
        - **Maltodextrin** is not labeled as a sugar, but functions nearly like one since it’s a starch that’s been made into shorter chains of glucose, making it easily digested. It’s been shown to be effective at spiking insulin levels,[5] but we can’t comment on what degree, especially compared to the D-glucose which is more prevalent in this formula.

    Ultimately, D-glucose / dextrose is what we want as our first ingredient – plus it tastes pretty sweet!

Why carbs in a post-workout?



Fructose reloads *liver* glycogen, but dextrose/glucose reload *muscle* glycogen. So why waste time with fructose or sucrose (which is half fructose)? Cut to the chase with straight up dextrose![1]

Low-carb and *ketogenic diets* with tons of protein are all the rage these days, and as we've seen during the past decade, people can *endlessly* debate the pros and cons of different nutritional philosophies.

The *old school* bodybuilding way is to consume protein *with plenty of carbohydrates*, which is the philosophy behind Universal Nutrition's Torrent formula. So what's the argument for doing this?

One simple argument is that we simply need more calories to gain weight – and there's only so much protein a sane human being can eat. The appropriate amount of carbohydrates can be loaded in the *muscle*, and fat can't – so gains-chasers generally rely on higher-carbohydrate diets, especially post-workout.

But in terms of actual muscle growth…

Do carbs increase the anabolic response?

Although this idea has been around forever, a 2013 research review points out that *very* few studies have been done over the decades. Specifically, *"no chronic study has addressed the effects of adding carbohydrate to protein compared to protein alone on muscle hypertrophy."*[6]

So the jury's out on this one – you'll have to make up your own mind. Some people swear by it, others prefer the metabolic effects of keeping carbohydrate intake low. And still others keep carbs low, but use products like Torrent in a *post-workout* setting to fuel glycogen reload.

Glycogen supports intense exercise

One thing is for certain: the *most intense* physical activity requires glycogen to burn.[7]

Although the scientific evidence seems clear on this, even *this* is not untouched by controversy – some people *swear* their top end power is unaffected by low-carb diets. At least as many athletes, though, find that they can't push themselves to the *max* without a good store of glycogen going into their workouts.

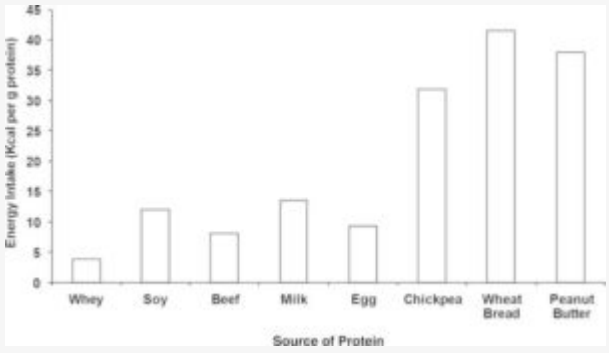
If you fall into that category, it behooves you to replenish glycogen within your anabolic window, when it's the easiest and most efficient.

During *intense exercise*, muscle glycogen stores get depleted, and should be replenished for optimal recovery. The amount of glycogen present in your muscles during the first 60 minutes or so after you finish your workout – a period often referred to as the "anabolic window" – is a major factor in how fast and how well you'll recover from the exercise.[8]

The *sooner* you get those carbs in after your workout, the better you'll absorb them and replenish glycogen.[8]

Keeping glycogen topped off 24/7 can help you *consistently* power through even the most challenging workouts.

- **Protein type and dose used**



When it comes to getting in large amounts of protein with fewer calories, whey protein is nearly always the go-to.

Universal Nutrition is sticking to the science with their *20 grams of protein* per dose of Torrent. It comes from **whey protein concentrate** and **whey protein hydrolysate** – most readers at this point should know the muscle-building and body composition benefits of boosting protein intake with whey protein.[9-12] Whey protein also has a very high digestibility/absorption score[13] – keeping up with an important trend in Torrent.

According to a large body of scientific research, gains on additional protein intake begin to diminish around 20-25 grams at once – any more than this and an increasing proportion of the protein you eat gets *oxidized for energy*, instead of being used to build muscle.[14]

So ultimately, you're led to a pretty cool blend of 20 grams of protein combined with 50 grams of carbohydrates and minimal fat (which is coming from the whey protein), leaving you with about 290 calories.

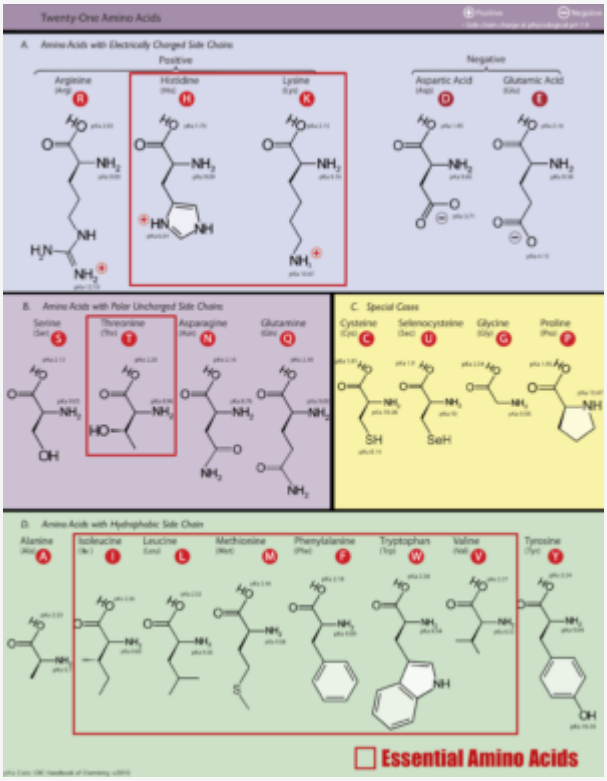
Now it's time to get into the post-workout *extras*:

- **Anti-Catabolic Leucine Complex – 8,000 mg**

  Purpose: preventing the unwanted breakdown (catabolism) of muscle tissue

  - **L-Leucine**

    Leucine is the best amino acid for *initiating the anabolic response*. It's been shown to *significantly* upregulate *muscle protein synthesis*[15-17] through *mammalian target of rapamycin* (mTOR) activation.[18-20]



Amongst these primary amino acids, the essential amino acids are in red. Leucine, Valine, and Isoleucine are the three *Branched-Chain* Amino Acids.

This helps keep your body *out* of a catabolic state, which can ultimately help you hang on to precious, hard-earned muscle. In fact, leucine has been discussed as a possible therapy for *muscle wasting*.[16]

Recommended leucine requirements go *up* as we age,[21] so if you're headed into your third decade of life (or beyond), supplementation is a smart thing to consider.

- **Leucine Alpha Ketoglutarate (AKG)**

  Next up we have **alpha ketoglutarate (AKG);** here, it's bound to *leucine*.

  You might be surprised to see an *exogenous ketone* in Torrent – after all, it's supposed to be a carb supplement.

  As it turns out, *exercise-trained muscles* have a greater ability to burn ketone bodies as fuel,[22] making this a *great* pre- or intra-workout supplement for athletes.

  AKG has even been studied for its ability to *help build muscle*,[23] which makes perfect sense when you consider that muscles love using their preferred fuel to grow!

Leucine ethyl ester & N-acetyl-L-leucine

Finally we have **N-acetyl-L-leucine (NALL)** and **leucine ethyl ester**. These forms of leucine have been around for a long time. Their purpose in Torrent is to *increase the leucine molecule's bioavailability* by attaching acetyl and ester groups to it.

In theory, the *acetylated* leucine should be more bioavailable than ordinary leucine, as pointed out in a 2021 study:

> *"Based on previous studies and our current results, we propose a mechanism of action of N-acetyl-leucine in which it is taken up and distributed by anion transporters, primarily MCT1… MCT1-mediated uptake of N-acetyl-l-leucine provides a way to bypass the easily saturable uptake via LAT1 to deliver* ***more leucine*** *to tissues… MCT1 can deliver leucine via the prodrug form N-acetyl-l-leucine* ***without interference*** *from, and disruption to, the uptake of other essential amino acids."[24]*

In other words, adding the acetyl group to leucine gives it an affinity for *different transporter proteins* than other amino acids, which means it can be metabolized *without competing for access to the same proteins*.

Other studies have found that NALL is powerfully *anti-inflammatory*. It's particularly good at reducing inflammation in the *brain* and has even been proposed as a potential *treatment* for traumatic brain injury.[25,26]

That's a great theory, and we find it persuasive. Nonetheless, it's important to tell readers that to the best of our knowledge, there are no *clinical studies* comparing the efficacy of NALL to ordinary leucine. Ditto for *leucine ethyl ester*.

So, although there's little evidence that these leucine forms are *more* effective than plain old L-leucine – at the same time,there's no evidence they're any *worse* than ordinary leucine, either.

So the bottom line here is that you're getting more leucine in different forms. There might be additional benefits, but we can't say that for sure.

- **Volubolic Amino Blend – 7,000 mg**

  Hydration and pumps aren't *just* for pre-workout situations – they can enhance

recovery as well:

- **Taurine**

A stack that's stood the test of time!

Taurine is one of our favorite ingredients because it has *so* many different benefits, and Universal's been including it since *before* it was the cool thing to do.

Taurine as an osmolyte and ergogenic aid

The main reason you see taurine in pre-workout and intra-workout supplements is because it's an *osmolyte*.[27] *Osmolytes* are substances that increase *cellular hydration* above baseline by increasing the osmotic pressure around your body's cells.

When your cells have more water, they also have access to additional *nutrients* and can more efficiently clear the waste produced by cellular metabolism. They're also more resilient to *heat stress*, which is a concern during tough workouts. The upshot is that once cells are in a state of *hyperhydration*, they can work hard for you *much longer* than normal, which manifests at scale as *increased athletic endurance*.[28]

Unlike fellow osmolyte and ergogenic aid creatine, taurine doesn't need to be "loaded". A 2018 meta-analysis showed that a 1-gram dose taken immediately before exercise is enough to confer endurance-boosting effects.[28]

Taurine is also a strong *antioxidant*[29,30] and can help facilitate muscle contractions by supporting calcium signaling in muscle cells.[31]

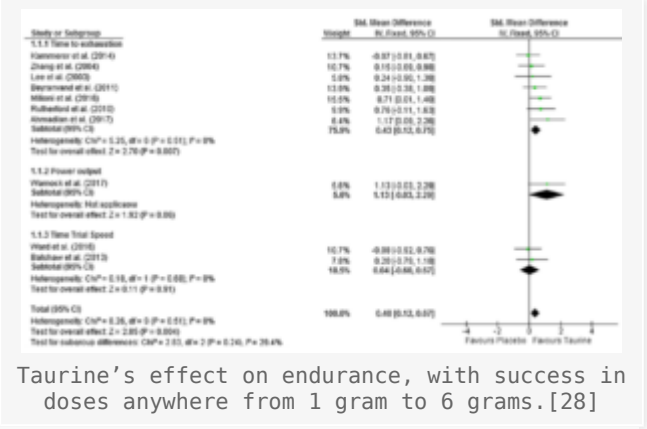
Taurine's cognitive effects

In the *central nervous system*, taurine acts as a GABAergic compound, meaning it mimics the action of the neurotransmitter *gamma-Aminobutyric acid* (GABA). As an *inhibitory* neurotransmitter, GABA *calms* neurons by downregulating certain types of activity.[32] This produces an *anti-inflammatory* effect. Taurine has also been shown to drive *mitochondrial biogenesis* in neurons.[32]

Anecdotally, users report that taurine helps take the edge off stimulants, which is one reason why supplement formulators are increasingly stacking it with caffeine.

Taurine's neuroprotective effects are part of the reason it can help *upregulate dopamine activity*.[33] Since dopamine increases focus and motivation, this is yet another benefit that makes taurine a great ingredient for supporting intense workouts.

Taurine's effects on body composition: brown adipose tissue (BAT)



Taurine's effect on endurance, with success in doses anywhere from 1 gram to 6 grams.[28]

Finally, taurine might be able to help you achieve and maintain your ideal physique by increasing your body's proportion of *brown adipose tissue* (BAT),[34] a metabolically active type of fat that's packed with mitochondria and burns calories as *heat*.

Taurine actually *converts* white adipose tissue (WAT), which is comparatively devoid of mitochondria and thus metabolically *inactive*, into BAT. Ultimately, this conversion increases the number of calories your body burns in a day,[35] making it easier to lose unwanted body fat and keep it off.

Taurine has even been shown to *selectively inhibit* the proliferation of new WAT cells, while allowing BAT cells to grow.[36]

If you'd like to lose a little extra weight, you should know that taurine can help *attenuate* the negative effects of excess body fat by tamping down on inflammation and blood glucose levels.[37]

Athletes have an increased need for taurine

If you exercise on a regular basis, you probably could benefit from taurine supplementation because it's *conditionally essential* and your metabolic requirements go up with activity, illness, and stress.[38]

- **L-Glutamine**

  Although it's recently fallen somewhat out of favor, **glutamine** is historically one of the most supplemented amino acids. Glutamine is a *conditionally essential* amino, meaning that your body can make some on its own, but requirements *increase* under metabolic stress – the kind of stress caused by intense exercise.

  Strenuous exercise is known to deplete glutamine stores. At that point, supplementation is advisable to bring them back up, both to prevent the onset of muscular fatigue and to maximize post-workout recovery.[39,40]

- **L-Phenylalanine**

  Phenylalanine is the precursor to *tyrosine*,[41] an amino acid that is, in turn, the precursor to *catecholamine* neurotransmitters, a category that includes dopamine, adrenaline, and noradrenaline.[42]

  Again, dopamine can help increase focus and motivation, and adrenaline and noradrenaline can help activate the *sympathetic nervous system*, which is responsible for the famous "fight or flight" response that helps us push ourselves in the gym.

Interestingly, phenylalanine can also increase your body's uptake of *leucine*,[43] which makes this a great amino to stack with the anti-

catabolic leucine complex we covered earlier.

Intense workouts tend to deplete phenylalanine,[44] so getting a little extra is probably not a bad thing when you're hitting the gym.

- **Citrulline malate**

  Citrulline is another sports supplement mainstay due to its ability to increase *nitric oxide* (NO) production.[45]

  Citrulline is another *conditionally essential* amino acid. So again, although your body can make a little on its own, stressing your metabolism with intense workouts *will* increase your requirement for citrulline. Supplementation can fill any gaps between the amount of citrulline your body needs and how much it has available f.

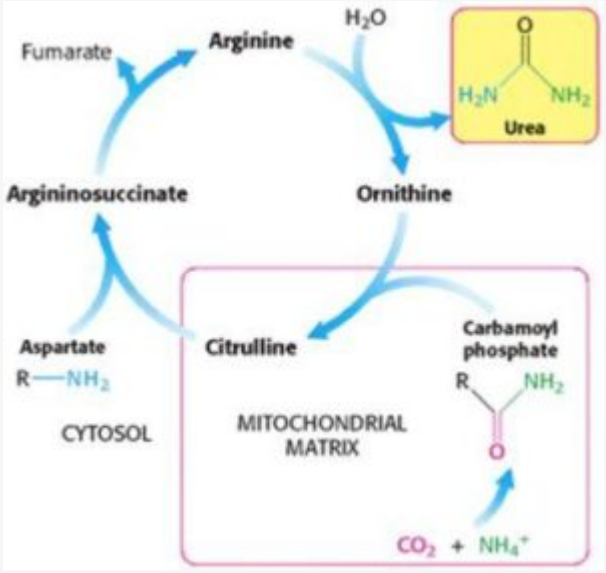
  The conversion pathway of citrulline-to-NO looks like this:

  Citrulline → Arginine → NO

  Seeing this, you might think it makes more sense to supplement with arginine instead – after all, it's a more direct precursor to NO. Using arginine as a NO booster was standard practice in the supplement industry for a long time, until it was discovered that citrulline is significantly more bioavailable [46,47] and better at raising arginine blood levels than oral arginine.[45] Since then, citrulline has largely replaced arginine in the NO-boosting role.

  Why nitric oxide (NO) matters

  The reason we *want* NO upregulation in a sports supplement is that NO is what primarily gives you the *pump* you're looking for in your workouts. This is because NO causes *vasodilation*, a mechanism that causes the *expansion of blood vessels* and improves whole-body circulation.



The Citrulline Pathway – This is how you get more arginine and then more nitric oxide

NO-induced vasodilation is associated with significant decreases in blood pressure and resting heart rate.[48-50] This effectively increases your capacity for physical work because you can push your body harder with your cardiovascular system being less of a limiting factor on performance.

Increased circulation brings key metabolic benefits. These include more efficient delivery of oxygen and nutrients to your cells, and more efficient removal of cellular-metabolic waste.

These benefits can help you perform better and recover faster.

The research on citrulline says that it can:

- Increase *power* by increasing oxygen use[51]
- Increase athletic endurance – by as much as 50% for at least one type of barbell lift[52]
- Reduce post-workout muscular soreness[52]
- Upregulate exercise-induced *growth hormone* (GH) production[53]
- Inhibit muscle breakdown (catabolism)[54]
- Amplify the *anabolic response* to workouts[55,56]

Citrulline → ornithine, ammonia clearance and DHEA production

Citrulline can also increase blood levels of *ornithine*,[57] an amino acid that helps clear *ammonia* from your body.[58]

Another “OG” supplement: Before organ meat consumption started trending back, one company has been telling you to eat liver all along: *Universal Nutrition* with their **Uni-Liver** tablets.

Since ammonia buildup can lead to physical and mental fatigue,[59,60] *clearing it faster*, which keeps concentrations low, may, theoretically, improve mental and physical endurance.

Ornithine also helps increase the body’s ratio of *cortisol to DHEA*, which can promote better sleep and lower levels of perceived stress.[58] This can be a boon for recovery from exercise.

Malate’s effect on cellular respiration

We are happy to see citrulline *malate* used in supplements because malate (malic acid) has some intriguing benefits of its own.

For example, it plays a crucial role in the *Krebs cycle*, your cells’ main energy production pathway.[61]

One study found that because of this, citrulline malate can improve *cellular aerobic respiration*, helping your cells power through tough workouts.[62]

- ## Creabolic complex

  Purpose: anabolic support and ergogenic aid

  - ### Creatine monohydrate

    Creatine is, hands-down, one of the most effective sports supplements ever brought to market.

For a more on-the-go delivery method, try out Universal's Animal Creatine Chews!

There's a *ton* of awesome research on creatine and the findings are equally impressive. Here's a list of benefits you can get from creatine supplementation:

- Increased power[63,64]
- Faster lean mass gain[15-17,19,20]
- Better sprinting performance[65-67]
- Improved cellular hydration (creatine is an *osmolyte* like taurine)[68]
- Higher energy levels[69-72]
- Greater feelings of well-being[73-75]
- Better cognition[76,77]
- Increased testosterone production[78-82]
- Higher bone density[83]

The last four items on this list are especially important if you're eating a *low-meat* or *meat-free* diet, since meat is the best dietary source of creatine by a wide margin.

Vegans and vegetarians should consider the possibility that their diet is not covering their creatine requirements, a problem that is easily solved by supplementation.

Creatine increases ATP production

Whenever we see a supplement that has such diverse and, seemingly, unrelated benefits, we like to look for a *biologically fundamental* mechanism of action.

That's exactly what we find in the case of creatine, which has been shown to *increase adenosine triphosphate* (ATP) *production*.[84-87]

If your body were an automobile, ATP would be the gasoline. The body uses it as the energy source for *all* tasks, whether they're mental or physical, microscopic or macroscopic.

- **Magnesium creatine chelate**

  With **magnesium creatine chelate**, you're getting all the benefits of creatine, *plus* the benefits of magnesium. And generally speaking, *chelation* is a great way to increase the bioavailability of almost any ingredient.

  The presence of *chelated magnesium* can potentially explain why Universal's creatine blend in Torrent is only dosed at 3 milligrams when the standard dose is 5 milligrams. A small body of research shows that magnesium chelate *is* more bioavailable than ordinary creatine monohydrate.[88]

  Benefits of magnesium

  The amount of magnesium present in Torrent isn't huge, but it's not negligible either (39 milligrams – 10% DV).

  Thanks to *crop monocultures* and other questionable agricultural practices, the amount of magnesium in our food has been steadily declining for over a century, putting increasing numbers of us at risk of magnesium deficiency.

Research shows that *correcting* even a mild magnesium deficiency can:

- Decrease blood pressure[89-92]
- Decrease HbA1c and improve glycemic control[89,93,94]
- Normalize insulin production[89,93,95]
- Increase insulin sensitivity[89,93,94,96]
- Reduce risk of type 2 diabetes[97-99]
- Increase bone mineralization[100]
- Alleviate PMS symptoms[101-104]
- Improve lactic acid clearance[105]
- Facilitate muscle gain[106]
- Reduce C-reactive protein[107] and mitigate its effects[106]
- Decrease levels of *interleukin 6* (IL-6), an inflammatory cytokine[108]
- Limit muscle breakdown during exercise[109]
- Improve migraine symptoms and frequency[110-112]

Suffice it to say, using some magnesium-bound creatine in Torrent should be considered a good thing as far as we're concerned.

- **Creatine gluconate**

  Creatine gluconate is another popular alternative to creatine monohydrate,on the basis of its allegedly superior bioavailability. However, so far as we know, human clinical trials of this claim have yet to be conducted.[113]

  We find the theory plausible since gluconic acid is highly water soluble,[114] but can't say definitively that it holds true in practice.

Regardless, we'll take any usable form of creatine to get our creatine numbers to the 3-5 gram goal of creatine per day.

Image courtesy @UniversalUSA on Instagram

Flavors Available

Conclusion

Torrent from Universal Nutrition contains a lot of old school bodybuilding ingredients that have been popular for many years.

We're not really sure about the use of *leucine ethyl ester* over standard leucine, and may follow-up more, but generally consider leucine to be a very effective amino acid. Creatine gluconate also has little data, but that's fine because we're mostly getting creatine monohydrate and magnesium creatine chelate.

As for everything else in here, we can say with certainty that they're all awesome ingredients that are great to take post-workout. Torrent is listed at a pretty attractive price point, and is definitely worth it for those who want to slug an extra 300 calories into their diet without chewing.

This formula is another example of Universal's attachment to what you might call *heuristic traditionalism*. One of the things that makes the brand unique is their nod to bodybuilding practices discovered through trial-and-error, which still could be valid, even if researchers haven't gotten around to studying them yet.

References

1. *Conlee, R, et al; "Effects of glucose or fructose feeding on glycogen repletion in muscle and liver after exercise or fasting"; Annals of Nutrition & Metabolism; 31(2):126-32; 1987; https://www.ncbi.nlm.nih.gov/pubmed/3592616*
2. *Bertoft, Eric, et al. "Building Block Organisation of Clusters in Amylopectin from Different Structural Types." International Journal of Biological Macromolecules, vol. 50, no. 5, June 2012, pp. 1212–1223, 10.1016/j.ijbiomac.2012.03.004; https://www.sciencedirect.com/science/article/abs/pii/S0141813012001018*
3. *Zhu, Fan, et al. "Characterization of Internal Structure of Maize Starch without Amylose and Amylopectin Separation." Carbohydrate Polymers, vol. 97, no. 2, Sept. 2013, pp. 475–481, 10.1016/j.carbpol.2013.04.092; https://pubmed.ncbi.nlm.nih.gov/23911473/*
4. *Sands A.L., Leidy H.J., Hamaker B.R., Maguire P, Campbell W.W. Consumption of the slow-digesting waxy maize starch leads to blunted plasma glucose and insulin response but does not influence energy expenditure or appetite in humans Nutrition Research. 2009; 29(6):383-390; https://www.ncbi.nlm.nih.gov/pubmed/19628104*
5. *Wilburn, Dylan T., et al. "Acute Maltodextrin Supplementation during Resistance Exercise." Journal of Sports Science & Medicine, vol. 19, no. 2, 1 May 2020, pp. 282–288; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7196753/*
6. *Figueiredo, Vandré Casagrande, and David Cameron-Smith. "Is carbohydrate needed to further stimulate muscle protein synthesis/hypertrophy following resistance exercise?." Journal of the International Society of Sports Nutrition vol. 10,1 42. 25 Sep. 2013, doi:10.1186/1550-2783-10-42; https://www.ncbi.nlm.nih.gov/pmc/articles/pmid/24066806/*
7. *Murray, Bob, and Christine Rosenbloom. "Fundamentals of glycogen metabolism for coaches and athletes." Nutrition reviews vol. 76,4 (2018): 243-259. doi:10.1093/nutrit/nuy001; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6019055/*
8. *Ivy, John L. "Regulation of muscle glycogen repletion, muscle protein synthesis and repair following exercise." Journal of sports science & medicine vol. 3,3 131-8. 1 Sep. 2004; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3905295/*
9. *Wirunsawanya, Kamonkiat, et al. "Whey Protein Supplementation Improves Body Composition and Cardiovascular Risk Factors in Overweight and Obese Patients: A Systematic Review and Meta-Analysis." Journal of the American College of Nutrition, vol. 37, no. 1, 31 Oct. 2017, pp. 60–70; https://pubmed.ncbi.nlm.nih.gov/29087242/*
10. *Naclerio, Fernando, and Eneko Larumbe-Zabala. "Effects of Whey Protein Alone or as Part of a Multi-Ingredient Formulation on Strength, Fat-Free Mass, or Lean Body Mass in Resistance-*

Trained Individuals: A Meta-Analysis." Sports Medicine, vol. 46, no. 1, 24 Sept. 2015, pp. 125–137, 10.1007/s40279-015-0403-y; https://pubmed.ncbi.nlm.nih.gov/26403469/

11. *Bergia, Robert E, et al. "Effect of Whey Protein Supplementation on Body Composition Changes in Women: A Systematic Review and Meta-Analysis." Nutrition Reviews, vol. 76, no. 7, 23 Apr. 2018, pp. 539–551, 10.1093/nutrit/nuy017; https://pubmed.ncbi.nlm.nih.gov/29688559/*
12. *Miller, Paige E., et al. "Effects of Whey Protein and Resistance Exercise on Body Composition: A Meta-Analysis of Randomized Controlled Trials." Journal of the American College of Nutrition, vol. 33, no. 2, 4 Mar. 2014, pp. 163–175, 10.1080/07315724.2013.875365; https://pubmed.ncbi.nlm.nih.gov/24724774/*
13. *Rutherfurd SM, Fanning AC, Miller BJ, Moughan PJ. Protein digestibility-corrected amino acid scores and digestible indispensable amino acid scores differentially describe protein quality in growing male rats. J Nutr. 2015;145(2):372-379. doi:10.3945/jn.114.195438. http://jn.nutrition.org/content/145/2/372.long*
14. *Schoenfeld, Brad Jon, and Alan Albert Aragon. "How much protein can the body use in a single meal for muscle-building? Implications for daily protein distribution." Journal of the International Society of Sports Nutrition vol. 15 10. 27 Feb. 2018, doi:10.1186/s12970-018-0215-1; https://www.ncbi.nlm.nih.gov/pmc/articles/pmid/29497353/*
15. *Anthony JC, Anthony TG, Kimball SR, Jefferson LS. Signaling pathways involved in translational control of protein synthesis in skeletal muscle by leucine. J Nutr. 2001 Mar;131(3):856S-860S. doi: 10.1093/jn/131.3.856S; https://pubmed.ncbi.nlm.nih.gov/11238774/*
16. *Ham DJ, Caldow MK, Lynch GS, Koopman R. Leucine as a treatment for muscle wasting: a critical review. Clin Nutr. 2014 Dec;33(6):937-45. doi: 10.1016/j.clnu.2014.09.016; https://pubmed.ncbi.nlm.nih.gov/25444557/*
17. *Mero A. Leucine supplementation and intensive training. Sports Med. 1999 Jun;27(6):347-58. doi: 10.2165/00007256-199927060-00001; https://pubmed.ncbi.nlm.nih.gov/10418071/*
18. *Lynch, Christopher J., et al. "Leucine Is a Direct-Acting Nutrient Signal That Regulates Protein Synthesis in Adipose Tissue." American Journal of Physiology-Endocrinology and Metabolism, vol. 283, no. 3, Sept. 2002, pp. E503–E513, 10.1152/ajpendo.00084.2002; https://journals.physiology.org/doi/full/10.1152/ajpendo.00084.2002*
19. *Lynch, Christopher J., et al. "Tissue-Specific Effects of Chronic Dietary Leucine and Norleucine Supplementation on Protein Synthesis in Rats." American Journal of Physiology-Endocrinology and Metabolism, vol. 283, no. 4, 1 Oct. 2002, pp. E824–E835, 10.1152/ajpendo.00085.2002; https://journals.physiology.org/doi/full/10.1152/ajpendo.00085.2002*
20. *Lynch, C. J., et al. "Regulation of Amino Acid-Sensitive TOR Signaling by Leucine Analogues in Adipocytes." Journal of Cellular Biochemistry, vol. 77, no. 2, 1 Mar. 2000, pp. 234–251; https://pubmed.ncbi.nlm.nih.gov/10723090/*
21. *Katsanos CS, Kobayashi H, Sheffield-Moore M, Aarsland A, Wolfe RR. A high proportion of leucine is required for optimal stimulation of the rate of muscle protein synthesis by essential amino acids in the elderly. Am J Physiol Endocrinol Metab. 2006 Aug;291(2):E381-7. doi: 10.1152/ajpendo.00488.2005; https://pubmed.ncbi.nlm.nih.gov/16507602/*
22. *Evans, Mark et al. "Metabolism of ketone bodies during exercise and training: physiological basis for exogenous supplementation." The Journal of physiology vol. 595,9 (2017): 2857-2871. doi:10.1113/JP273185 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5407977/*
23. *Gyanwali, Bibek et al. "Alpha-Ketoglutarate dietary supplementation to improve health in humans." Trends in endocrinology and metabolism: TEM vol. 33,2 (2022): 136-146. doi:10.1016/j.tem.2021.11.003 https://pubmed.ncbi.nlm.nih.gov/34952764/*
24. *Churchill, Grant C et al. "Acetylation turns leucine into a drug by membrane transporter switching." Scientific reports vol. 11,1 15812. 4 Aug. 2021, doi:10.1038/s41598-021-95255-5q https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8338929/*
25. *Sarkar, Chinmoy, and Marta M Lipinski. "N-acetyl-L-leucine: a promising treatment option for traumatic brain injury." Neural regeneration research vol. 17,9 (2022): 1957-1958. doi:10.4103/1673-5374.335146 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8338929/*
26. *Hegdekar, Nivedita et al. "N-Acetyl-L-leucine improves functional recovery and attenuates cortical cell death and neuroinflammation after traumatic brain injury in mice." Scientific reports vol. 11,1 9249. 29 Apr. 2021, doi:10.1038/s41598-021-88693-8 https://pubmed.ncbi.nlm.nih.gov/33927281/*
27. *Pasantes-Morales, H., et al. "Taurine: An Osmolyte in Mammalian Tissues." Advances in Experimental Medicine and Biology, 1998, pp. 209–217, 10.1007/978-1-4899-0117-0_27; https://link.springer.com/chapter/10.1007/978-1-4899-0117-0_27*
28. *Waldron, M., et al. May 2018. "The Effects of an Oral Taurine Dose and Supplementation*

Period on Endurance Exercise Performance in Humans: A Meta-Analysis." Sports Medicine vol. 48,5; 1247-53; https://pubmed.ncbi.nlm.nih.gov/29546641

29. *Ibrahim, Marwan A et al. "Therapeutic role of taurine as antioxidant in reducing hypertension risks in rats." Heliyon vol. 6,1 e03209. 17 Jan. 2020, doi:10.1016/j.heliyon.2020.e03209; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6970174/*
30. *Jong, Chian Ju et al. "Mechanism underlying the antioxidant activity of taurine: prevention of mitochondrial oxidant production." Amino acids vol. 42,6 (2012): 2223-32. doi:10.1007/s00726-011-0962-7; https://pubmed.ncbi.nlm.nih.gov/21691752/*
31. *Spriet, Lawrence L, and Jamie Whitfield. "Taurine and skeletal muscle function." Current opinion in clinical nutrition and metabolic care vol. 18,1 (2015): 96-101. doi:10.1097/MCO.0000000000000135; https://pubmed.ncbi.nlm.nih.gov/25415270/*
32. *Chen, C. et al. Aug. 2019. "Roles of Taurine in Cognitive Function of Physiology, Pathologies, and Toxication." Life Sciences vol. 15, 231; https://pubmed.ncbi.nlm.nih.gov/31220527/*
33. *Wang, Ke, et al. "Taurine Improves Neuron Injuries and Cognitive Impairment in a Mouse Parkinson's Disease Model through Inhibition of Microglial Activation." NeuroToxicology, vol. 83, Mar. 2021, pp. 129–136, 10.1016/j.neuro.2021.01.002; https://www.sciencedirect.com/science/article/abs/pii/S0161813X21000085*
34. *Kim, Kyoung Soo et al. "Taurine Stimulates Thermoregulatory Genes in Brown Fat Tissue and Muscle without an Influence on Inguinal White Fat Tissue in a High-Fat Diet-Induced Obese Mouse Model." Foods (Basel, Switzerland) vol. 9,6 688. 26 May. 2020, doi:10.3390/foods9060688; https://www.ncbi.nlm.nih.gov/pmc/articles/pmid/32466447/*
35. *Guo, Ying-Ying et al. "Taurine-mediated browning of white adipose tissue is involved in its anti-obesity effect in mice." The Journal of biological chemistry vol. 294,41 (2019): 15014-15024. doi:10.1074/jbc.RA119.009936; https://www.ncbi.nlm.nih.gov/pmc/articles/pmid/31427436/*
36. *Kim, Kyoung Soo et al. "Anti-obesity effect of taurine through inhibition of adipogenesis in white fat tissue but not in brown fat tissue in a high-fat diet-induced obese mouse model." Amino acids vol. 51,2 (2019): 245-254. doi:10.1007/s00726-018-2659-7; https://dx.doi.org/10.1007/s00726-018-2659-7*
37. *Lin, Shan et al. "Taurine improves obesity-induced inflammatory responses and modulates the unbalanced phenotype of adipose tissue macrophages." Molecular nutrition & food research vol. 57,12 (2013): 2155-65. doi:10.1002/mnfr.201300150; https://doi.org/10.1002/mnfr.201300150*
38. *Ripps, H. et al. Nov. 2012. "Review: Taurine: A "Very Essential Amino Acid." Molecular Vision vol. 18. 2673-86; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3501277/*
39. *Legault, Zachary et al. "The Influence of Oral L-Glutamine Supplementation on Muscle Strength Recovery and Soreness Following Unilateral Knee Extension Eccentric Exercise." International journal of sport nutrition and exercise metabolism vol. 25,5 (2015): 417-26. doi:10.1123/ijsnem.2014-0209 https://pubmed.ncbi.nlm.nih.gov/25811544/*
40. *Koo, Ga Hee et al. "Effects of Supplementation with BCAA and L-glutamine on Blood Fatigue Factors and Cytokines in Juvenile Athletes Submitted to Maximal Intensity Rowing Performance." Journal of physical therapy science vol. 26,8 (2014): 1241-6. doi:10.1589/jpts.26.1241 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4155228/*
41. *Fernstrom, John D, and Madelyn H Fernstrom. "Tyrosine, phenylalanine, and catecholamine synthesis and function in the brain." The Journal of nutrition vol. 137,6 Suppl 1 (2007): 1539S-1547S; discussion 1548S. doi:10.1093/jn/137.6.1539S https://pubmed.ncbi.nlm.nih.gov/17513421/*
42. *National Center for Biotechnology Information. "PubChem Compound Summary for CID 6140, Phenylalanine" PubChem; https://pubchem.ncbi.nlm.nih.gov/compound/Phenylalanine*
43. *Smith, K., et al. "Effects of Flooding Amino Acids on Incorporation of Labeled Amino Acids into Human Muscle Protein." The American Journal of Physiology, vol. 275, no. 1, 1 July 1998, pp. E73-78, 10.1152/ajpendo.1998.275.1.E73; https://pubmed.ncbi.nlm.nih.gov/9688876/*
44. *Davison G, Vinaixa M, McGovern R, Beltran A, Novials A, Correig X, McClean C. Metabolomic Response to Acute Hypoxic Exercise and Recovery in Adult Males. Front Physiol. 2018 Nov 26;9:1682. doi: 10.3389/fphys.2018.01682; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6275205/*
45. *Morita, Masahiko, et al; "Oral Supplementation with a Combination of L-Citrulline and L-Arginine Rapidly Increases Plasma L-Arginine Concentration and Enhances NO Bioavailability."; Biochemical and Biophysical Research Communications; U.S. National Library of Medicine; 7 Nov. 2014; https://www.ncbi.nlm.nih.gov/pubmed/25445598*
46. *Ochiai, Masayuki, et al; "Short-Term Effects of L-Citrulline Supplementation on Arterial Stiffness in Middle-Aged Men."; International Journal of Cardiology; U.S. National Library*

of Medicine; 8 Mar. 2012; https://www.ncbi.nlm.nih.gov/pubmed/21067832

47. *Agarwal, Umang et al; "Supplemental Citrulline Is More Efficient Than Arginine in Increasing Systemic Arginine Availability in Mice."; The Journal of nutrition; vol. 147,4; 2017; 596-602; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5368575/*
48. *Orozco-Gutiérrez, Juan José, et al. "Effect of L-Arginine or L-Citrulline Oral Supplementation on Blood Pressure and Right Ventricular Function in Heart Failure Patients with Preserved Ejection Fraction." Cardiology Journal, vol. 17, no. 6, 2010, pp. 612–618; https://pubmed.ncbi.nlm.nih.gov/21154265/*
49. *Wong A, Alvarez-Alvarado S, Jaime SJ, Kinsey AW, Spicer MT, Madzima TA, Figueroa A. Combined whole-body vibration training and l-citrulline supplementation improves pressure wave reflection in obese postmenopausal women. Appl Physiol Nutr Metab. 2016 Mar;41(3):292-7. doi: 10.1139/apnm-2015-0465; https://cdnsciencepub.com/doi/10.1139/apnm-2015-0465*
50. *Alsop P, Hauton D. Oral nitrate and citrulline decrease blood pressure and increase vascular conductance in young adults: a potential therapy for heart failure. Eur J Appl Physiol. 2016 Sep;116(9):1651-61. doi: 10.1007/s00421-016-3418-7; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4983290/*
51. *Bailey, Stephen J, et al; "l-Citrulline Supplementation Improves O2 Uptake Kinetics and High-Intensity Exercise Performance in Humans."; Journal of Applied Physiology (Bethesda, Md. : 1985); U.S. National Library of Medicine; 15 Aug. 2015; https://www.ncbi.nlm.nih.gov/pubmed/26023227*
52. *Pérez-Guisado, Joaquín, and Philip M Jakeman; "Citrulline Malate Enhances Athletic Anaerobic Performance and Relieves Muscle Soreness."; Journal of Strength and Conditioning Research; U.S. National Library of Medicine; May 2010; https://www.ncbi.nlm.nih.gov/pubmed/20386132*
53. *Sureda A, Córdova A, Ferrer MD, Pérez G, Tur JA, Pons A. L-citrulline-malate influence over branched chain amino acid utilization during exercise. Eur J Appl Physiol. 2010 Sep;110(2):341-51. doi: 10.1007/s00421-010-1509-4; https://link.springer.com/article/10.1007/s00421-010-1509-4*
54. *Breuillard C, Cynober L, Moinard C. Citrulline and nitrogen homeostasis: an overview. Amino Acids. 2015 Apr;47(4):685-91. doi: 10.1007/s00726-015-1932-2; https://link.springer.com/article/10.1007/s00726-015-1932-2*
55. *Jourdan M, Nair KS, Carter RE, Schimke J, Ford GC, Marc J, Aussel C, Cynober L. Citrulline stimulates muscle protein synthesis in the post-absorptive state in healthy people fed a low-protein diet – A pilot study. Clin Nutr. 2015 Jun;34(3):449-56. doi: 10.1016/j.clnu.2014.04.019; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4309748/*
56. *Bahri S, Zerrouk N, Aussel C, Moinard C, Crenn P, Curis E, Chaumeil JC, Cynober L, Sfar S. Citrulline: from metabolism to therapeutic use. Nutrition. 2013 Mar;29(3):479-84. doi: 10.1016/j.nut.2012.07.002; https://www.sciencedirect.com/science/article/abs/pii/S0899900712002584?via%3Dihub*
57. *Agarwal, Umang, et al. "Supplemental Citrulline Is More Efficient than Arginine in Increasing Systemic Arginine Availability in Mice123." The Journal of Nutrition, vol. 147, no. 4, 1 Apr. 2017, pp. 596–602; 10.3945/jn.116.240382; https://academic.oup.com/jn/article/147/4/596/4584706*
58. *Miyake, Mika, et al. "Randomised Controlled Trial of the Effects of L-Ornithine on Stress Markers and Sleep Quality in Healthy Workers." Nutrition Journal, vol. 13, no. 1, 3 June 2014, 10.1186/1475-2891-13-53; https://nutritionj.biomedcentral.com/articles/10.1186/1475-2891-13-53*
59. *Mutch, B J, and E W Banister. "Ammonia metabolism in exercise and fatigue: a review." Medicine and science in sports and exercise vol. 15,1 (1983): 41-50. https://pubmed.ncbi.nlm.nih.gov/6341752/*
60. *Wilkinson, Daniel J et al. "Ammonia metabolism, the brain and fatigue; revisiting the link." Progress in neurobiology vol. 91,3 (2010): 200-19. doi:10.1016/j.pneurobio.2010.01.012; https://pubmed.ncbi.nlm.nih.gov/20138956/*
61. *"Malic Acid: Uses, Side Effects, Interactions, Dosage, and Warning." WebMD; https://www.webmd.com/vitamins/ai/ingredientmono-1495/malic-acid*
62. *Bendahan, D. "Citrulline/Malate Promotes Aerobic Energy Production in Human Exercising Muscle." British Journal of Sports Medicine, vol. 36, no. 4, 1 Aug. 2002, pp. 282–289, 10.1136/bjsm.36.4.282; https://bjsm.bmj.com/content/36/4/282*
63. *Rawson ES, Volek JS. Effects of creatine supplementation and resistance training on muscle strength and weightlifting performance. J Strength Cond Res. 2003 Nov;17(4):822-31; https://pubmed.ncbi.nlm.nih.gov/14636102/*
64. *Branch, J David. "Effect of Creatine Supplementation on Body Composition and Performance: A*

Meta-Analysis.” International Journal of Sport Nutrition and Exercise Metabolism, vol. 13, no. 2, 2003, pp. 198–226, 10.1123/ijsnem.13.2.198; https://pubmed.ncbi.nlm.nih.gov/12945830/

65. *Bogdanis, G C, et al. “Recovery of Power Output and Muscle Metabolites Following 30 S of Maximal Sprint Cycling in Man.” The Journal of Physiology, vol. 482, no. 2, 15 Jan. 1995, pp. 467–480, 10.1113/jphysiol.1995.sp020533; https://www.ncbi.nlm.nih.gov/pubmed/7714837*
66. *Mendez-Villanueva, Alberto, et al. “The Recovery of Repeated-Sprint Exercise Is Associated with PCr Resynthesis, While Muscle PH and EMG Amplitude Remain Depressed.” PLoS ONE, vol. 7, no. 12, 17 Dec. 2012, p. e51977, 10.1371/journal.pone.0051977; https://www.ncbi.nlm.nih.gov/pubmed/23284836*
67. *Mielgo-Ayuso, Juan, et al. “Effects of Creatine Supplementation on Athletic Performance in Soccer Players: A Systematic Review and Meta-Analysis.” Nutrients, vol. 11, no. 4, 31 Mar. 2019, p. 757, 10.3390/nu11040757; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6520963/*
68. *Lopez, Rebecca M et al. “Does creatine supplementation hinder exercise heat tolerance or hydration status? A systematic review with meta-analyses.” Journal of athletic training vol. 44,2 (2009): 215-23. doi:10.4085/1062-6050-44.2.215; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2657025/*
69. *Sakellaris, George, et al. “Prevention of Traumatic Headache, Dizziness and Fatigue with Creatine Administration. A Pilot Study.” Acta Paediatrica, vol. 97, no. 1, 3 Dec. 2007, pp. 31–34, 10.1111/j.1651-2227.2007.00529.x; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2583396/*
70. *Anomasiri, Wilai, et al. “Low Dose Creatine Supplementation Enhances Sprint Phase of 400 Meters Swimming Performance.” Journal of the Medical Association of Thailand = Chotmaihet Thangphaet, vol. 87 Suppl 2, 1 Sept. 2004, pp. S228-232; https://pubmed.ncbi.nlm.nih.gov/16083193/*
71. *Schneider-Gold, C., et al. “Creatine Monohydrate in DM2/PROMM: A Double-Blind Placebo-Controlled Clinical Study.” Neurology, vol. 60, no. 3, 11 Feb. 2003, pp. 500–502, 10.1212/01.wnl.0000044405.29988.e1; https://pubmed.ncbi.nlm.nih.gov/12578937/*
72. *McMorris, T., et al. “Effect of Creatine Supplementation and Sleep Deprivation, with Mild Exercise, on Cognitive and Psychomotor Performance, Mood State, and Plasma Concentrations of Catecholamines and Cortisol.” Psychopharmacology, vol. 185, no. 1, 17 Jan. 2006, pp. 93–103, 10.1007/s00213-005-0269-z; https://pubmed.ncbi.nlm.nih.gov/16416332/*
73. *McMorris, T., et al. “Effect of Creatine Supplementation and Sleep Deprivation, with Mild Exercise, on Cognitive and Psychomotor Performance, Mood State, and Plasma Concentrations of Catecholamines and Cortisol.” Psychopharmacology, vol. 185, no. 1, 17 Jan. 2006, pp. 93–103, 10.1007/s00213-005-0269-z; https://pubmed.ncbi.nlm.nih.gov/16416332/*
74. *Fuld, J P. “Creatine Supplementation during Pulmonary Rehabilitation in Chronic Obstructive Pulmonary Disease.” Thorax, vol. 60, no. 7, 1 July 2005, pp. 531–537, 10.1136/thx.2004.030452; https://pubmed.ncbi.nlm.nih.gov/15994258/*
75. *Braegger, Christian P., et al. “Effects of Creatine Supplementation in Cystic Fibrosis: Results of a Pilot Study.” Journal of Cystic Fibrosis: Official Journal of the European Cystic Fibrosis Society, vol. 2, no. 4, 1 Dec. 2003, pp. 177–182; 10.1016/S1569-1993(03)00089-4; https://pubmed.ncbi.nlm.nih.gov/15463870/*
76. *Rae, Caroline et al. “Oral creatine monohydrate supplementation improves brain performance: a double-blind, placebo-controlled, cross-over trial.” Proceedings. Biological sciences vol. 270,1529 (2003): 2147-50. doi:10.1098/rspb.2003.2492; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1691485/*
77. *Benton, David, and Rachel Donohoe. “The Influence of Creatine Supplementation on the Cognitive Functioning of Vegetarians and Omnivores.” The British Journal of Nutrition, vol. 105, no. 7, 2011, pp. 1100–5, 10.1017/S0007114510004733; https://www.cambridge.org/core/journals/british-journal-of-nutrition/article/influence-of-creatine-supplementation-on-the-cognitive-functioning-of-vegetarians-and-omnivores/E2D37729902DDFA6CFC85767AD0421FC*
78. *Schilling, Brian K., et al. “Creatine Supplementation and Health Variables: A Retrospective Study.” Medicine & Science in Sports & Exercise, vol. 33, no. 2, 2001, pp. 183–188; https://journals.lww.com/acsm-msse/Fulltext/2001/02000/Creatine_supplementation_and_health_variables__a.2.aspx*
79. *Hoffman, Jay, et al. “Effect of Creatine and ß-Alanine Supplementation on Performance and Endocrine Responses in Strength/Power Athletes.” International Journal of Sport Nutrition and Exercise Metabolism, vol. 16, no. 4, Aug. 2006, pp. 430–446, 10.1123/ijsnem.16.4.430; https://pubmed.ncbi.nlm.nih.gov/17136944/*
80. *Cook, Christian J, et al. “Skill Execution and Sleep Deprivation: Effects of Acute Caffeine or Creatine Supplementation – a Randomized Placebo-Controlled Trial.” Journal of the International Society of Sports Nutrition, vol. 8, no. 1, 16 Feb. 2011,*

10.1186/1550-2783-8-2; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3049131/

81. *Volek, Jeff S., et al. "The Effects of Creatine Supplementation on Muscular Performance and Body Composition Responses to Short-Term Resistance Training Overreaching." European Journal of Applied Physiology, vol. 91, no. 5-6, 1 May 2004, pp. 628–637, 10.1007/s00421-003-1031-z; https://pubmed.ncbi.nlm.nih.gov/14685870/*
82. *Sheikholeslami Vatani, D., et al. "The Effects of Creatine Supplementation on Performance and Hormonal Response in Amateur Swimmers." Science & Sports, vol. 26, no. 5, Nov. 2011, pp. 272–277, 10.1016/j.scispo.2011.07.003; https://www.sciencedirect.com/science/article/abs/pii/S0765159711001171*
83. *Chilibeck, P. D., et al. "Creatine Monohydrate and Resistance Training Increase Bone Mineral Content and Density in Older Men." The Journal of Nutrition, Health & Aging, vol. 9, no. 5, 2005, pp. 352–353; https://pubmed.ncbi.nlm.nih.gov/16222402/*
84. *Mujika, I., and S. Padilla. "Creatine Supplementation as an Ergogenic Aid for Sports Performance in Highly Trained Athletes: A Critical Review." International Journal of Sports Medicine, vol. 18, no. 07, Oct. 1997, pp. 491–496, 10.1055/s-2007-972670; https://www.ncbi.nlm.nih.gov/pubmed/9414070*
85. *Terjung, RL, et al; "Physiological and Health Effects of Oral Creatine Supplementation." Medicine & Science in Sports & Exercise, vol. 32, no. 3, Mar. 2000, pp. 706–717, 10.1097/00005768-200003000-00024; https://www.ncbi.nlm.nih.gov/pubmed/10731017*
86. *Guzun, R., et al. "Systems Bioenergetics of Creatine Kinase Networks: Physiological Roles of Creatine and Phosphocreatine in Regulation of Cardiac Cell Function." Amino Acids, vol. 40, no. 5, 10 Mar. 2011, pp. 1333–1348, 10.1007/s00726-011-0854-x; https://www.ncbi.nlm.nih.gov/pubmed/21390528*
87. *Adhihetty, Peter J., and M. Flint Beal. "Creatine and Its Potential Therapeutic Value for Targeting Cellular Energy Impairment in Neurodegenerative Diseases." NeuroMolecular Medicine, vol. 10, no. 4, 13 Nov. 2008, pp. 275–290, 10.1007/s12017-008-8053-y; https://www.ncbi.nlm.nih.gov/pubmed/19005780*
88. *Zajac, Adam et al. "The Effects of Long-Term Magnesium Creatine Chelate Supplementation on Repeated Sprint Ability (RAST) in Elite Soccer Players." Nutrients vol. 12,10 2961. 28 Sep. 2020, doi:10.3390/nu12102961 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7600931/*
89. *Guerrero-Romero, Fernando, and Martha Rodríguez-Morán. "Magnesium Improves the Beta-Cell Function to Compensate Variation of Insulin Sensitivity: Double-Blind, Randomized Clinical Trial." European Journal of Clinical Investigation, vol. 41, no. 4, 17 Jan. 2011, pp. 405–410, 10.1111/j.1365-2362.2010.02422.x; https://pubmed.ncbi.nlm.nih.gov/21241290/*
90. *Hatzistavri, L. S., et al. "Oral Magnesium Supplementation Reduces Ambulatory Blood Pressure in Patients with Mild Hypertension." American Journal of Hypertension, vol. 22, no. 10, 1 Oct. 2009, pp. 1070–1075, 10.1038/ajh.2009.126; https://pubmed.ncbi.nlm.nih.gov/19617879/*
91. *Kawano, Yuhei, et al. "Effects of Magnesium Supplementation in Hypertensive Patients." Hypertension, vol. 32, no. 2, Aug. 1998, pp. 260–265, 10.1161/01.hyp.32.2.260; https://pubmed.ncbi.nlm.nih.gov/9719052/*
92. *Guerrero-Romero, F, and M Rodríguez-Morán. "The Effect of Lowering Blood Pressure by Magnesium Supplementation in Diabetic Hypertensive Adults with Low Serum Magnesium Levels: A Randomized, Double-Blind, Placebo-Controlled Clinical Trial." Journal of Human Hypertension, vol. 23, no. 4, 20 Nov. 2008, pp. 245–251, 10.1038/jhh.2008.129; https://pubmed.ncbi.nlm.nih.gov/19020533/*
93. *Rodriguez-Moran, M., and F. Guerrero-Romero. "Oral Magnesium Supplementation Improves Insulin Sensitivity and Metabolic Control in Type 2 Diabetic Subjects: A Randomized Double-Blind Controlled Trial." Diabetes Care, vol. 26, no. 4, 1 Apr. 2003, pp. 1147–1152, 10.2337/diacare.26.4.1147; https://pubmed.ncbi.nlm.nih.gov/12663588/*
94. *Mooren, F. C., et al. "Oral Magnesium Supplementation Reduces Insulin Resistance in Non-Diabetic Subjects – a Double-Blind, Placebo-Controlled, Randomized Trial." Diabetes, Obesity and Metabolism, vol. 13, no. 3, 24 Jan. 2011, pp. 281–284, 10.1111/j.1463-1326.2010.01332.x; https://pubmed.ncbi.nlm.nih.gov/21205110/*
95. *Golf, S.W., et al. Cardiovascular Drugs and Therapy, vol. 12, no. 2suppl, 1998, pp. 197–202, 10.1023/a:1007708918683; https://pubmed.ncbi.nlm.nih.gov/9794094/*
96. *Simental-Mendía LE, Sahebkar A, Rodríguez-Morán M, Guerrero-Romero F. A systematic review and meta-analysis of randomized controlled trials on the effects of magnesium supplementation on insulin sensitivity and glucose control. Pharmacol Res. 2016 Sep;111:272-282. doi: 10.1016/j.phrs.2016.06.019; https://pubmed.ncbi.nlm.nih.gov/27329332/*
97. *Hruby A, Guasch-Ferré M, Bhupathiraju SN, Manson JE, Willett WC, McKeown NM, Hu FB. Magnesium Intake, Quality of Carbohydrates, and Risk of Type 2 Diabetes: Results From Three U.S. Cohorts. Diabetes Care. 2017 Dec;40(12):1695-1702. doi: 10.2337/dc17-1143; https://pubmed.ncbi.nlm.nih.gov/28978672/*

98. Fang X, Han H, Li M, Liang C, Fan Z, Aaseth J, He J, Montgomery S, Cao Y. Dose-Response Relationship between Dietary Magnesium Intake and Risk of Type 2 Diabetes Mellitus: A Systematic Review and Meta-Regression Analysis of Prospective Cohort Studies. Nutrients. 2016 Nov 19;8(11):739. doi: 10.3390/nu8110739; https://pubmed.ncbi.nlm.nih.gov/27869762/

99. Zhao B, Deng H, Li B, Chen L, Zou F, Hu L, Wei Y, Zhang W. Association of magnesium consumption with type 2 diabetes and glucose metabolism: A systematic review and pooled study with trial sequential analysis. Diabetes Metab Res Rev. 2020 Mar;36(3):e3243. doi: 10.1002/dmrr.3243; https://pubmed.ncbi.nlm.nih.gov/31758631/

100. Carpenter, Thomas O., et al. "A Randomized Controlled Study of Effects of Dietary Magnesium Oxide Supplementation on Bone Mineral Content in Healthy Girls." The Journal of Clinical Endocrinology & Metabolism, vol. 91, no. 12, Dec. 2006, pp. 4866–4872, 10.1210/jc.2006-1391; https://www.ncbi.nlm.nih.gov/labs/pmc/articles/PMC2995550/

101. Ebrahimi, Elham, et al. "Effects of Magnesium and Vitamin B6 on the Severity of Premenstrual Syndrome Symptoms." Journal of Caring Sciences, vol. 2012, no. 4, pp. 183–189, 10.5681/jcs.2012.026; https://www.ncbi.nlm.nih.gov/labs/pmc/articles/PMC4161081/

102. Quaranta, S., et al. "Pilot Study of the Efficacy and Safety of a Modified-Release Magnesium 250 Mg Tablet (Sincromag) for the Treatment of Premenstrual Syndrome." Clinical Drug Investigation, vol. 27, no. 1, 2007, pp. 51–58, 10.2165/00044011-200727010-00004; https://pubmed.ncbi.nlm.nih.gov/17177579/

103. Walker, Ann F., et al. "Magnesium Supplementation Alleviates Premenstrual Symptoms of Fluid Retention." Journal of Women's Health, vol. 7, no. 9, Nov. 1998, pp. 1157–1165, 10.1089/jwh.1998.7.1157; https://pubmed.ncbi.nlm.nih.gov/9861593/

104. Facchinetti, F., et al. "Oral Magnesium Successfully Relieves Premenstrual Mood Changes." Obstetrics and Gynecology, vol. 78, no. 2, 1991, pp. 177–181; https://pubmed.ncbi.nlm.nih.gov/2067759/

105. Zhang, Yijia et al. "Can Magnesium Enhance Exercise Performance?." Nutrients vol. 9,9 946. 28 Aug. 2017, doi:10.3390/nu9090946; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5622706/

106. Welch, Ailsa A, et al. "Dietary Magnesium Is Positively Associated with Skeletal Muscle Power and Indices of Muscle Mass and May Attenuate the Association between Circulating C-Reactive Protein and Muscle Mass in Women." Journal of Bone and Mineral Research, vol. 31, no. 2, 11 Sept. 2015, pp. 317–325, 10.1002/jbmr.2692; https://asbmr.onlinelibrary.wiley.com/doi/10.1002/jbmr.2692

107. Simental-Mendia LE, Sahebkar A, Rodriguez-Moran M, Zambrano-Galvan G, Guerrero-Romero F. Effect of Magnesium Supplementation on Plasma C-reactive Protein Concentrations: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Curr Pharm Des. 2017;23(31):4678-4686. doi: 10.2174/1381612823666170525153605; https://pubmed.ncbi.nlm.nih.gov/28545353/

108. Steward CJ, Zhou Y, Keane G, Cook MD, Liu Y, Cullen T. One week of magnesium supplementation lowers IL-6, muscle soreness and increases post-exercise blood glucose in response to downhill running. Eur J Appl Physiol. 2019 Dec;119(11-12):2617-2627. doi: 10.1007/s00421-019-04238-y; https://pubmed.ncbi.nlm.nih.gov/31624951/

109. Córdova A, Mielgo-Ayuso J, Roche E, Caballero-García A, Fernandez-Lázaro D. Impact of Magnesium Supplementation in Muscle Damage of Professional Cyclists Competing in a Stage Race. Nutrients. 2019 Aug 16;11(8):1927. doi: 10.3390/nu11081927; https://pubmed.ncbi.nlm.nih.gov/31426321/

110. Chiu HY, Yeh TH, Huang YC, Chen PY. Effects of Intravenous and Oral Magnesium on Reducing Migraine: A Meta-analysis of Randomized Controlled Trials. Pain Physician. 2016 Jan;19(1):E97-112. https://pubmed.ncbi.nlm.nih.gov/26752497/

111. von Luckner A, Riederer F. Magnesium in Migraine Prophylaxis-Is There an Evidence-Based Rationale? A Systematic Review. Headache. 2018 Feb;58(2):199-209. doi: 10.1111/head.13217; https://pubmed.ncbi.nlm.nih.gov/29131326/

112. Shahrami A, Assarzadegan F, Hatamabadi HR, Asgarzadeh M, Sarehbandi B, Asgarzadeh S. Comparison of therapeutic effects of magnesium sulfate vs. dexamethasone/metoclopramide on alleviating acute migraine headache. J Emerg Med. 2015 Jan;48(1):69-76. doi: 10.1016/j.jemermed.2014.06.055; https://pubmed.ncbi.nlm.nih.gov/25278139/

113. Andres, Susanne et al. "Creatine and creatine forms intended for sports nutrition." Molecular nutrition & food research vol. 61,6 (2017): 10.1002/mnfr.201600772. doi:10.1002/mnfr.201600772Z; https://doi.org/10.1002/mnfr.201600772

114. "Gluconic Acid – an Overview | ScienceDirect Topics." ScienceDirect; https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/gluconic-acid