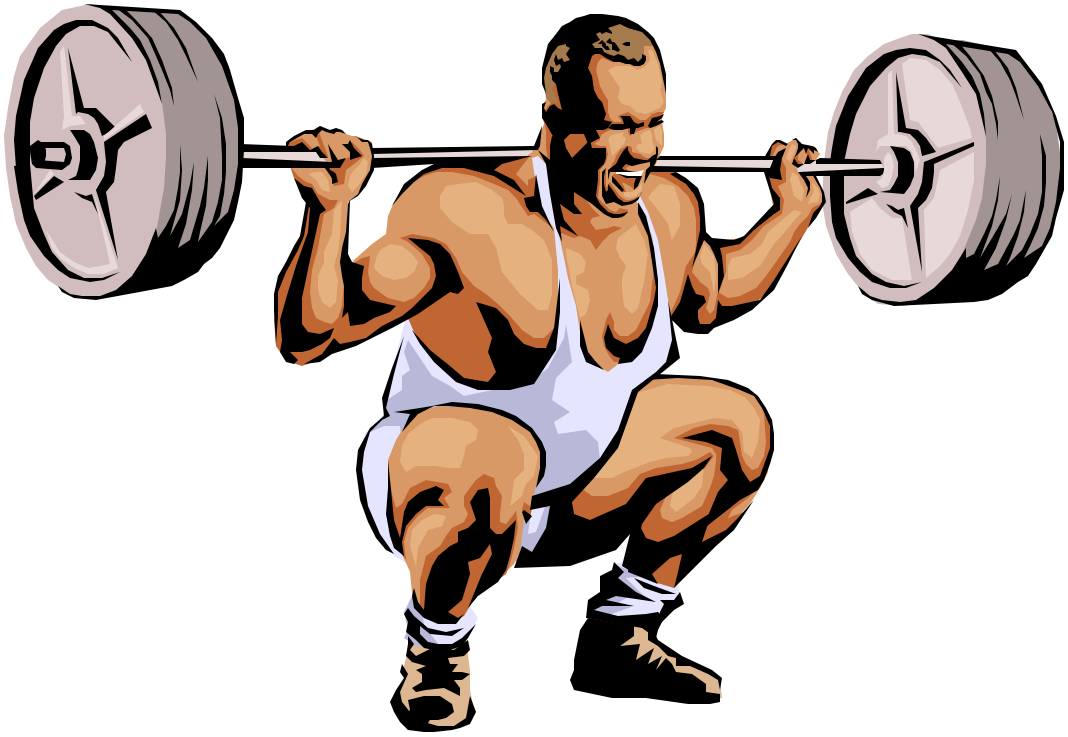
Creatine Monohydrate



How To Maximize Muscle Mass Gains

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Creatine Monohydrate

In recent years, the most beneficial advancement in sports supplementation has been the advent of creatine monohydrate. Creatine is wildly effective in increasing strength and is a natural, legal compound. To illustrate its positive benefits, it is first important to establish certain biochemical processes. Don't get scared off - these processes are very easy to understand and will let you understand clearly why creatine works so well at increasing strength.

The Adenosine TriPhosphate - Phosphocreatine Energy Cycle

Adenosine TriPhosphate (ATP) is the most basic fuel for all muscular contractions. A lot of you are saying, " I thought glucose (carbohydrates) / fatty acids (fat) are where energy comes from?!" This is not entirely correct. Your body derives energy from molecules when it breaks them down. The energy comes from the bonds that hold the molecules together. Hence, when you break a molecule down, you release some of the energy that was used to hold the larger molecule together - and the body uses that free energy as fuel. The same holds true for glucose and fatty acids. The body doesn't break them down directly for energy, it breaks them down so that it can produce ATP. That ATP (produced from the breakdown of glucose/fatty acids) is then used SPECIFICALLY to fuel muscular contractions. So on the most basic level, ATP is the energy used by the body to fuel muscular contractions.

There are three basic systems for energy production in the body: the anaerobic, aerobic and ATP-PC systems. The ATP-PC system is the one of relevance to creatine supplementation. ATP-PC stands for Adenosine TriPhosphate-Phosphocreatine. Here's how it works.

The ATP-PC system is used by the body for high intensity demands that are very short (typically under a minute in duration). The body has a limited amount of ATP already tucked away in the muscle. When it is suddenly forced with a high intensity demand - it needs energy on the go. It cannot wait for the relatively slow breakdown of glucose and fatty acids. The Adenosine Tri-Phosphate (three phosphorus molecules) stored in the muscle is broken down into Adenosine DI-Phosphate (two phosphorus molecules) and one free phosphorus molecule. This produces energy which is obviously used by the muscle. The problem with this system is that it is very limited. The body only stores an amount of ATP good enough for 10-20 seconds of high intensity muscle contractions. What happens after this point? This is where Phosphocreatine comes in. The body also stores a small amount of PC in the muscle. After all the ATP has been broken down into ADP and one P molecule, Phosphocreatine is broken down. What this produces is Creatine and one free Phosphorus molecule. There is also energy produced. Why is this relevant? There is a new phosphorus molecule and some energy! Remember that ADP molecule

sitting around and doing nothing? Well, now that there is a new phosphorus molecule floating around... the energy produced from the PC breakdown joins together the ADP with that Phosphorus molecule...voila! New, regenerated ATP. Hence, Phosphocreatine is responsible for ATP regeneration. This process is almost instantaneous and is why you can sustain high intensity demands for longer than 10-20 seconds.

Great stuff, this phosphocreatine. Unfortunately - as aforementioned - there is only a limited supply found within the muscle. Researchers thought, "If we could increase the amount of phosphocreatine, wouldn't we also increase the body's ability to produce high intensity contractions?" That's where Creatine Monohydrate supplementation comes in.

Creatine Monohydrate: How does it fit in?

We obtain the majority of nutrients in our body directly from food sources. For example, vitamins are directly usable upon ingestion. However, the same does not hold true for creatine. While it is true that creatine is found in meat and fish, this is not where the body obtains the majority of the creatine in muscles. Herring has the highest food creatine content, however, the creatine molecule is inherently destroyed through heating. Therefore, unless you eat the fish raw, even the highest creatine containing food in the end probably contains hardly significant levels. In fact, the body actually constructs creatine itself by synthesizing it in the liver with creatine's base amino acids. So your body naturally produces most of the creatine already in muscles. However, this amount of creatine produced is not close to the levels attainable through supplementation. So it is unrealistic to think that one can get the same effects of creatine supplementation through diet alone.

However, there is a problem here. Creatine naturally degrades into creatinine. Creatinine is a waste product and is excreted in urine. The body loses approximately 2g of creatine a day through urine. This is offset by natural creatine production, however, it becomes obvious that the need for creatine supplementation is all the more important. By the way, no one has ever been able to augment muscle creatine stores significantly through the supplementation of its three constituent amino acids. By far the most effective form of supplementation is through creatine monohydrate.

Diet also has another impact on creatine stores; people who do not eat sufficient protein typically have lower creatine stores in their body. Their body simply does not have enough of the constituent amino acids to synthesize creatine, furthermore, the small amount readily supplied in meat and fish is not present either. As such, vegetarians are especially receptive towards creatine supplementation and usually see larger increases in progress simply because they operate at lower levels to begin with. This is not a sign to go vegetarian and start utilizing creatine; the end result is perhaps worse for vegetarians because they need to make up for the deficit through supplementation. As a result, it is

significantly more expensive for a vegetarian to reach creatine saturation in the body than for a person who follows a properly constructed diet. Vegetarianism is not conducive to athletic success, nutritionally
speaking.

At first, researchers started supplementing with oral Phosphocreatine (also known as Creatine Phosphate). The problem with this is that the molecule is too big to be handled properly by the digestive system, and as a result, is ineffective for increasing muscular Phosphocreatine levels. Don't buy Creatine Phosphate - there is some indication that if injected, it will work properly, but otherwise - it's worthless if taken orally.

To solve this problem, researchers considered using a smaller molecule to transport the creatine into the muscles. This is where Creatine Monohydrate comes in. Creatine Monohydrate is handled more efficiently by the digestive system. "But how does it work? It's not quite the same molecule...". That is exactly true - it is not the same molecule. However, once inside the body, creatine monohydrate can be converted into Phosphocreatine. Remember that the phosphocreatine molecule is composed of creatine and phosphorus. Most people get more than enough naturally occurring phosphorus in their diet. Consequently, when you add more creatine to the picture - there is more creatine phosphate produced. Phosphorus intake looks to be a limiting reagent, so ensuring that more than enough is taken in might enhance the benefits of Creatine Monohydrate supplementation.

In essence, more creatine monohydrate = more phosphocreatine = more potential ATP = more strength / speed.

Creatine Facts

Most supplement companies will tout creatine as being "steroid alternatives", that athletes typically gain an instant 10 lbs. of LEAN BODY MASS while initially loading on creatine. This is true, however, it is not the entire story. First of all, when we refer to "Lean Body Mass", we refer to all tissues in the body that is not body fat. That includes organs, bones, tendons, ligaments, and muscles. It also includes the water naturally stored in the system. Creatine Monohydrate causes water to be drawn into the muscle cell by osmosis (i.e. like sand sucks up water). The larger amount of water retained by the body accounts for the initial rapid weight gain. This does not constitute an instant increase in protein synthesis (muscular growth), simply that more water is in the system. This explains why athletes who go on creatine not only gain a certain amount of weight, but also have "larger looking muscles". The increased intramuscular water retention causes the muscles to appear more full and round, giving the illusion of enhanced size. Don't allow yourself to be fooled - you do not instantly gain 10 lbs. of muscle when going on creatine, you gain 10 lbs. of water.

This is not to say that creatine does not enhance muscle protein synthesis (growth). In a round about way, it certainly does. Most importantly - since creatine monohydrate allows one to regenerate more ATP, it increases strength. Increases in strength allows for workouts which are more productive - you can work with heavier weights and do more repetitions. If you can work with heavier weights and do more reps with that weight - you are going to be generating greater intensity. Greater intensity, obviously, results in greater progress. Creatine Monohydrate has a large impact on muscular growth because of the inherent strength enhancement associated with it. Creatine monohydrate also positively affects speed for the same reasons above. The greater amount of ATP allows for speed to be sustained over longer periods of time. This translates to faster performances.

It has already been stated that creatine causes water to be drawn into the muscle cell. This also has a beneficial impact on protein synthesis. Cellular hydration is directly linked to the performance of the muscle cell. As outlined in this article on hydration, maintaining sufficient levels of water in the body increases contractile strength, speed and efficiency. The muscle grows faster when it has an efficient environment to work in. The efficiency of the environment is directly related to hydration, and since CM increases cellular hydration - it increases the speed at which muscle protein is synthesized.

Creatine and creatine phosphate levels also play a role in muscle protein catabolism. When the body runs out of ATP, large amounts of branched chain amino acids are released from the muscle for energy demands. This causes a loss in muscle mass. Obviously, Phosphocreatine levels play a large role in how badly this effect occurs. Larger amounts of Phosphocreatine create more ATP, which better protects the muscle against this catabolic process. Less branched chain amino acids are needed if there are sufficient levels of ATP to fuel workouts.

The positive benefits of creatine monohydrate can remain in the system long after supplementation ceases. If creatine cost is a problem, one can typically still reap the benefits of enhanced Phosphocreatine levels for two months after they stop using it. The body still stays saturated with Phosphocreatine and slowly decreases.

Obviously, it is clear that creatine monohydrate supplementation is highly beneficial to athletes.

How to use Creatine Monohydrate Effectively

It is recommended that one uses two phases to administer creatine: a "loading" phase and a "maintenance" phase. During the loading phase, the intent is to saturate the system with as much creatine as the body can store. The intent of the maintenance phase is to obviously maintain that saturation - to "top off the tank" when necessary. Maintenance dosages are necessary to replace the spent Phosphocreatine which will inevitably be lost during exercise. It is not necessary to repeatedly utilize "loading phases" if creatine monohydrate dosages are not disrupted. As aforementioned, the body stays somewhat saturated for approximately 2 months after dosages have stopped - so every time you buy a new bottle, you don't have to load up if it hasn't been that long since your last loading phase.

Typically, it is recommended that athletes under 220 lbs. use 5 x 5g doses of CM, for a total of 25 grams daily. These dosages should be spread apart evenly throughout the day. It is recommended that maintenance dosages for these athletes is a single 5g dose per day. Recent research indicates that athletes over 220 lbs. will require more CM during the loading and maintenance phases to maintain saturation. The guidelines for such athletes is 6 x 5g doses during the loading phase, and 2 x 5g doses during the maintenance phase. It also stands to reason from that this athletes significantly smaller than 180 lbs. (i. e. 150 lbs. or so) will not need as much creatine as the regular dosage. By the 5th day of supplementation, studies have shown that the body is essentially saturated with creatine. This means that you are just "topping off the tank" on this day, ensuring the muscles are fully loaded. If you are not particularly active during the loading phase, it is conceivable that less loading time will be required.When you add workouts to the picture, creatine is obviously being used, so more time is needed to ensure saturation.

However, this is not the only technique in saturating the body with creatine. Saturation can also be reached by taking 1 x 5g doses steadily. As aforementioned, the body loses approximately 2g of creatine per day due to creatine degradation, so by supplementing with amounts slightly higher than those lost, eventually one will reach a level of saturation in their body. Of course, because this method saturates the system slowly over time, it does take significantly longer. Furthermore, the dramatic jumps in strength that people normally see after a loading phase are far more subtle with this approach because the improvements occur a little at a time. Personally, one can use either approach. This method of loading slowly is economically more appropriate (you use significantly less creatine, but still achieve saturation, although it does take longer). The loading / maintenance approach is more appropriate if you wish to start seeing results right away and aren't worried about a small increase in cost of supplementation. It should be noted that this approach to saturating the body with creatine has not been well documented in research. However, anecdotal evidence suggest that either approach is equally effective at saturating the body. The

choice is really yours: results right now at a slightly higher cost or results later with some money saved.

Another important issue is the method of intake into the body. A popular practice at present is to combine creatine with simple sugars (glycemic index of 90 and above). What this does is cause a spike in insulin production, which helps the body to store creatine more effectively. My original problem with this approach was that simple sugars push insulin sufficiently high enough to cause fat storage, as such, one has to be careful not to go overboard. The next question that arises is, how much sugar is necessary to produce the desired effect? At present, there are no studies to indicate the optimal amount. However, to minimize fat storage and to still achieve the benefits of simple sugars, I believe that it is reasonable to take the creatine with a small amount of sugars; equivalent 15-20 grams of carbohydrates. With further study, we may learn what is the optimal level of sugar to ingest, but at present, I would rather play things safe than sorry.

Previously, I had thought that simply combining creatine supplementation with meals would provide a sufficient insulin burst to store creatine effectively. However, several studies have indicated that simple sugars are still the best approach to use when you want the body to retain as much creatine as possible. In fact, in one of the studies; there were several subjects who had utilized creatine monohydrate before but had not seen significant results. However, when they tried supplementation again, but this time utilized simple sugars as well - their results were improved dramatically. Once again, we must consider the fat storage issue. If you are going to supplement with simple sugars along with your creatine monohydrate, I suggest that you do this between meals to minimize the amount of fat stored. Furthermore, the effect that you want will be achieved. If a small amount of simple sugars are combined with a meal that is largely low glycemic, the amount of insulin secreted will be limited. Why? Well, insulin secretion is based as much on the AMOUNT of the type of food you eat. So if you eat 100g of sugar (high glycemic) and 10g of oatmeal (low glycemic), there is going to be more insulin produced because there is more high glycemic crabs than low glycemic. However, most of the food you eat will be stored as fat. If you eat 100g of oatmeal (low glycemic) and 10g of sugar (high glycemic), insulin secretion will be much lower because most of the food is low glycemic. So if you want the desired effect of simple sugars with creatine, do it in isolation of other foods. I suggest using a small amount of juice - preferably grape, a high sugar variety - 1/2 cup. Ingest the juice first, then mix the creatine into some water and drink the creatine solution.

How well you dissolve the creatine also plays an important role in supplementation. If the creatine is better dissolved, it is absorbed faster into the bloodstream. In addition, the better you dissolve the creatine - the less gastrointestinal distress you encounter. There is a habit of putting the creatine into your mouth and then chasing it down with some water to ensure that no creatine is lost. I suggest that you instead mix the creatine thoroughly in a glass of water, and continue filling the glass with water until all of it is gone. Hey, what's

the worst that can happen?

The creatine will be absorbed better by your body and you'll get a little extra water in your day, maybe save yourself a case of upset stomach and diarrhea. It should be noted that creatine does not dissolve particularly well. Some people have found that combining the creatine with water that is slightly warm or hot provides better results. I don't think it really matters in the long run, as long as it is dissolved a little bit better than simply washing the powder down with water.

The importance of staying adequately hydrated while supplementing with creatine monohydrate cannot be sufficiently underlined. CM is stored inside the muscle cells. However, this is directly limited by the amount of water present inside the cell. If there is insufficient water within the cell, creatine monohydrate will not be properly absorbed because it supersaturates the cell. Think about a glass full of water representing the muscle cell. If one dumps a bag of sand into the glass, the amount of sand that combines with the water and stores in the glass is limited by the amount of water present. As a result, drink as much water possible when loading on creatine.

It should also be noted that creatine capsules are not absorbed as efficiently as the powder. Capsules have to be digested, creatine (when combined with water) is absorbs faster through the digestive system simply because it is in liquid form. Creatine should not be combined with hot liquids, as this changes the chemical structure of the monohydrate molecule.

Problems with Creatine Supplementation

At present, there has been no conclusive data suggested that supplementing with creatine monohydrate is detrimental to one's health. No negative side effects have yet been noted. However, there are several important questions to be considered.

First of all; there has been some unwarranted concern that creatine causes problems with the kidneys. This is not true. Let me explain the situation. Healthy kidney function is often assessed by measuring blood and urine creatinine levels. Remember creatinine is the waste product that occurs due to the natural degradation of creatine in the body. However, high creatinine levels USUALLY indicate kidney damage. Remember that if you augment the amount of creatine in the body; you are also going to augment the amount of creatine degraded, and hence, the amount of creatinine excreted. So creatinine levels in urine and blood will rise. Now, if you go and get a physical examination for an insurance company, etc. while utilizing creatine, your blood/urine creatinine levels will be unnaturally high. This will make the company think you are having kidney problems, but this is not the case. The creatinine in your urine/blood is because of creatine supplementation, NOT because of a problem with your kidney. So make sure that you make this clear to your

doctor or insurance company if you are going to have blood tests. It's a false positive for the testing and the high creatinine levels are NOT indicative of kidney damage when utilizing creatine monohydrate.

We already know that normal amounts of creatine naturally produced by the body degrades. This has been measured to be approximately 2g a day - however, this is when the body has "normal" levels of creatine. What happens when the body has "above normal" levels of creatine? Obviously, from the situation we just talked about, we know that more creatine is excreted as creatinine. How much is excreted, no study has been successful to identify yet. However, this poses an interesting question; do we need to reload on creatine systematically to ensure that levels are saturated in the body? Creatine is going to degrade no matter what. So just because we have more creatine in our system means that more creatine is going to naturally degrade. Perhaps this signifies a need to systematically reload the system - use a little bit more than our maintenance dosages - to ensure proper saturation. Further study will clarify this situation. If you do wish to experiment with "mini-reloads" - i.e. every 6-8 weeks, reloading with 5-20 grams of creatine for 2-3 days - watch for the amount of gastrointestinal distress you encounter. As will be explained below; if you find you are experiencing diarrhea, gas or upset stomach - do not be alarmed - this is simply a signal to cease or cut back on creatine intake for a little bit (1 or 2 days should do the trick nicely).

There are rumors that creatine, when combined with orange juice or caffeine, limits the effectiveness of the supplementation. These rumors are also equally untrue.

Creatine and orange juice do not cause any problems or any decrement in effectiveness. Some people say that the citric acid in orange juice degrades creatine into creatinine. This does not make much sense consider the acids in our stomach are much more acidic than citric acid. If citric acid can simply destroy creatine, then there is no way it would be able to make it past our stomach alive. So obviously, this rumor does not make much sense. In so far as caffeine limiting the effectiveness of creatine, it also makes little sense. The very first studies published on creatine supplementation were done so where creatine was ingested with coffee or tea! So obviously; caffeine CANNOT limit the effectiveness of creatine supplementation because these were the studies that initially proved creatine's powers. There was, however, one study which showed that caffeine did affect Phosphocreatine stores. There were many problems with this study, however. Amounts of creatine taken into the muscles were exactly the same wit or without caffeine (coffee). Unfortunately, the errors in this study did not stop it from making thousands of people avoid taking creatine with caffeine. It's okay to use both together, and no study has conclusively proven any limit in efficacy in doing so.

At this point in time it is not known what the long term effects of creatine monohydrate supplementation will be. That is not to say that there aren't any, and equally as much - it is

If one uses TOO MUCH creatine, they can also expects some minor problems with their digestive system. This isn't something to get particularly worried about. Basic physiology tells us that when the digestive system encounters a foreign presence or something that the body does not need, it speeds the transfer through the intestine. This speeds up excretion. What this results in is gas, diarrhea and upset stomach. This is by no means dangerous to one's system - just an indication that creatine monohydrate dosages should be decreased as the body is already saturated and is rejecting the excess. If you find you are exhibiting these symptoms, cut back on your supplementation.

Another question raised is that creatine monohydrate supplementation augments levels of Phosphocreatine produced naturally by the body. Some people believe that since homeostasis is disrupted, there could be a possibility that this could also disrupt how much Phosphocreatine the body naturally produces. There has been no substantiation of this hypothesis yet, but there is a basis for the argument. Take anabolic steroids for example. Excessive abuse causes the body to shut down natural production of testosterone because so much is being externally administered. When the athlete goes off the steroids, their testosterone function is permanently disrupted. Whether or not this applies to creatine monohydrate supplementation is not clear and does not seem to be true based on anecdotal / personal experience. Nonetheless it is something to consider.

People worry that creatine monohydrate will be banned by certain athletic organizations due to its positive influence. This is not feasible. Even if creatine monohydrate usage were banned, it would be impossible to detect athletes who did use it. Creatine is a naturally occurring compound found in meats and fish. There is no way that the governing bodies can regulate what the athlete's eat. Unlike steroids - CM does not leave a chemical signature behind that makes it easy to identify.

Buying Creatine Monohydrate

When buying creatine monohydrate, one should ensure that they purchase 99% to 100% pharmaceutical grade creatine monohydrate. This is as clean as you can get. As long as you ensure the quality is good, the only issue to be considered is price and quantity. Buy the largest, cheapest, highest quality creatine you can find. There has been some recent attention given to certain companies who cheat their customers - in that their products don't really contain any creatine at all. Try to stick to reputable manufacturers. Exercise common sense. If there is a blasting cap and broken glass floating around in the creatine, or the bottle is being held together by duct tape - look elsewhere. If the price is too good to be true, it most probably is.

There are also creatine products on the market which contain more than just creatine monohydrate. Some products include "high glycemic carbohydrates" (sugar) and certain amino acids. These are not necessary to obtain the full benefits of creatine monohydrate.

Typically these products, called "creatine transport systems", cost significantly more than pure creatine monohydrate. In essence, you are only paying for additional sugar and some amino acids. If the high glycemic effect (aforementioned) is what you are looking for - you can obtain the same effect by simply combining your pure, cheap creatine monohydrate with your favorite sugary juice. Even Kool-Aid works here. As a result, buying brand names or creatine-transport products are not necessary.

Creatine Citrate may seem like a cheap alternative to creatine monohydrate - but in truth, it is pure crap. Creatine Citrate has never been shown in independent studies to increase intramuscular Phosphocreatine stores, and as a result doesn't achieve the same effect of CM. Furthermore, the companies who sell creatine citrate argue that it is better absorbed than CM. This is based purely on the fact that Creatine Citrate dissolves better in water. There is no substantiation that Creatine Citrate is absorbed better in the body - and even if it was, who cares? It's never been shown to have a positive effect.

Conclusion

From personal experience, creatine monohydrate is outstanding. I highly recommend it. I noticed an instant improvement in strength and size while using it. Coupled with high intensity training and a proper diet, creatine monohydrate is another weapon that every natural athlete should have in their arsenal.

Summary

1. Creatine increases the amount of Phosphocreatine in the body. More Phosphocreatine allows for more ATP to be generated. More ATP allows for gains in strength and size.

2. Normal creatine levels in the body naturally degrade into creatinine, a waste product. Creatinine is excreted through urine. There is approximately 2g of creatine lost per day for normal levels.

3. The initial rapid weight gain that accompanies creatine supplementation is due to an increase in water retention, not due to an increase in muscle.

4. Creatine might help augment protein synthesis (muscle growth) through cellular volumization.

5. The body remains saturated with creatine for approximately 1 month after supplementation has stopped. Hence, you can still see an improvement in performance from creatine even if you are not taking it anymore.

6. The most effective way to increase performance through creatine supplementation is to use a loading phase / maintenance phase approach. This provides the fastest results.

7. For athletes under 220 lbs. it is generally recommended to use 25 grams of creatine for 5 days split into 5 gram dosages spread evenly throughout the day. Maintenance dosage is 5g per day.

8. For athletes over 220 lbs. it is recommended to follow the same approach but use 30 grams for each of the 5 days. Maintenance dosage is 10g per day.

9. Saturation can also be achieved without a loading phase, but it takes a longer time to see the effects. Generally, 5g per day for 1 month will saturate the system. However, the effects of this approach have not been documented in clinical study but anecdotal evidence has proved it to be just as effective, albeit less quick.

10. Creatine should be taken with a small amount (15-20g) of simple sugars (glycemic index 90 and above), between meals, to improve absorption through increased insulin secretion.

11. Have the sugars first (juice is preferred), then mix the creatine in ample water and drink it.

12. Better dissolved creatine is absorbed more efficiently by the body.

13. There is no data that shows creatine monohydrate supplementation is dangerous to one's health.

14. Kidney function is not affected by creatine supplementation. High blood/urine creatinine levels are not due to kidney damage but rather to increased levels of creatine in the body. This is not a dangerous situation but should be conveyed to your doctor or insurance company should you be taking any blood tests; as this improperly affects the conclusion drawn from the samples.

15. "Mini-reloading phases" may be necessary to maintain a level of saturation in the body. However, the need for this has not yet been proven through study and as such is up to the user's discretion to use or not. Creatine is naturally excreted by the body. If the amount of creatine in the body is increased, so is the amount excreted. Consequently it may be necessary to increase creatine ingestion systematically to ensure a state of saturation at all times.

16. Citric acid and caffeine do not limit the effectiveness of creatine monohydrate whatso-

17. The long term effects of creatine supplementation are not known.

18. Excessive creatine supplementation causes gastrointestinal distress (i.e. gas, upset stomach, diarrhea). If you exhibit these symptoms you are using too much creatine and should cut back on your supplementation dosage schedule to regulate your system back to normal.

19. Buy the highest quantity, 100% Pharmaceutical grade creatine you can find. No product is superior to another simply based on brand. As long as it is 100% pharmaceutical grade, you can't get anything better. As such, the only issue becomes price and quantity.

20. Creatine transport systems - which contain premixed simple sugars - are a waste of money.