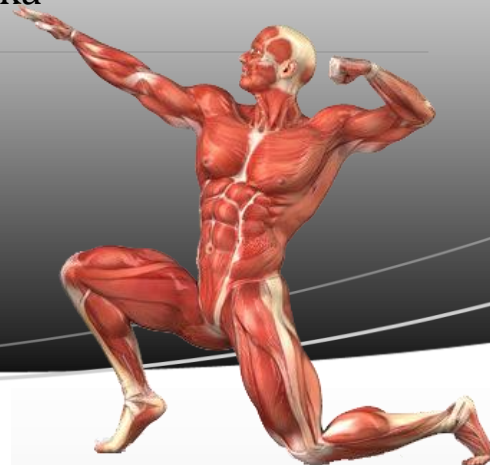


Surveying Selected Performance Enhancing Supplements

By: Tony Rice & Shaun Robotka



Introduction:

Dietary supplements have been looked at for years to see if there are any performance enhancing effects. This project looks into several of these supplements that seem to have a beneficial effect on performance. First of all, a little background is needed on dietary supplements. A dietary supplement is “...a product (other than tobacco) that is intended to supplement the diet; contains one or more dietary ingredients (including vitamins, minerals, herbs or other botanicals, amino acids, and other substances) or their constituents; is intended to be taken by mouth as a pill, capsule, tablet, or liquid; and is labeled on the front panel as being a dietary supplement” (Gahche et al., 2011).

Top Five Best Selling Creatine on the Market:

1. Promera Sports Con-Cret
2. Optimum Nutrition micronized Creatine Powder
3. Musclesharm Creatine
4. RSP Nutrition Creade
5. Bodybuilding.com Foundation Series Micronized Creatine



Not just athletes use supplements; many sedentary people use these supplements to make sure they are getting the right amount of nutrients in their diets. In the year 2011, the Center for Disease Control and Prevention (CDC) said that over half the American population used dietary supplements. These supplement companies have a 15.5 billion dollar annual industry with a wide range of supplements to choose from (Schultz, 2012). Supplements industries went through much change over the years, with it all starting way back to ancient Greece. They started ingesting mixtures of their version of “supplements” in their diet to increase warriors’ performance. Fast forward a few thousand years and the word Vitamin was coined in 1912, and by the 1930’s were used a supplement for athletes.

Another supplement that also started in the 1930’s was protein. Scientists began processing whey protein out of milk for human consumption. Sometime after that, amino acid supplements became popular in sports in the 1980’s (Machemehl et al., 2014). Ten years after amino acids, creatine started to gain popularity very quickly after being prevailed in the 1990’s (Mueller & Hingst, 2013).

After all these different supplements started to hit the shelves, none of them were regulated and had no instructions or warnings. The FDA was in charge of labeling everything. Not until 1994 when the Food and Drug Administration (FDA) passed the Dietary Supplement Health and Education Act of 1994 (DSHEA), which gave the companies permission to release a product without an FDA approval. Today, the companies only need a warning label of the FDA’s recommendations on the supplement. After looking at some background of supplements, there seems to be a wide range of supplements out there.

There are four different supplements looked at in this project: creatine, colostrum, and chromium. These supplements were chosen because research has shown they give an advantage to performance. Currently all of these supplements have no ban of use from the NCAA. Each of these supplements will be looked at in depth to see exactly how they increase performance.

Literature Review:

This literature review will focus on the research towards performance enhancing supplements such as creatine, colostrum, and chromium and the associated benefits that come with each supplement. Throughout the articles, the supplement that was under examination went through a series of tests to prove its beneficial powers. For example, creatine is listed as improving performance by increasing energy, muscle mass, strength, power, and slowing down the onset of fatigue. To prove this, researchers have looked at short-term and long-term creatine supplementation and the affect on performance. Articles that studied short-term, just to name a few, saw an increase in bench press reps, peak cycling power, maximal power, extended work period, and reduced sprinting times. Just like the articles for short-term, long-term benefits seen some of the same results. Just like creatine, colostrum to has many benefits towards strength and stamina as well as boosting immune system functions. The study done by Cesarone et al. (2007) compared colostrum to the flu vaccine to see



which one would be more effective preventing the flu. Results revealed colostrum to be three times more effective than the flu vaccine (Cesarone et al., 2007) Coombes et al. (2002) went a different route and looked at the athletic advantages of consuming colostrum. They found a 20% increase in strength, stamina, and a shorten recovery time. Chromium, on the other hand, is much different from creatine and colostrum. Chromium picolinate helps increase fat-free mass and memory. The study done by Edwards et al. (2012) took division 1 female swimmers and over the course of the season the ones who took chromium picolinate decreased in overall percent body fat. While Edwards et al. (2012) looked at the benefits from the physical point of view, Krikorian et al. (2010) looked at the psychological benefits. After the 12 weeks, the older adults who consumed chromium picolinate saw an improvement in cognitive-cerebral function (Krikorian et al., 2010).

Creatine:

Creatine is a relatively new supplement that hadn't been developed till the 1990's. Since the release of creatine, people have been raving over the product. In just 2009, this supplement alone brought in around \$2.7 billion in annual sales (Jager, et al. 2011). Everyone was trying this product. Creatine was listed as improving performance by increasing energy, increasing muscle mass, reducing fatigue, increasing strength, and increasing power. All of these could have great implications when dealing with performance. In order to understand these potential performance-enhancing attributes, some review of skeletal muscle is needed.

Skeletal muscles are muscle tissues that are under voluntary control. They all have a motor neuron that carries signals from the brain to a designated location of skeletal muscle. Depending on the situation, different muscles will be activated to perform a certain task. An example would be playing tennis, and activating the bicep muscles and forearm muscles to properly hit the tennis ball over the net. In order to see how creatine would affect these muscles, one must go deeper into the skeletal muscle function. Skeletal muscle requires energy in order to contract and relax. This energy is like a currency, and is in the form of adenine triphosphate, also called ATP for short. The high-energy phosphates are used in the cross bridge cycling, which is the way skeletal muscle contracts.



Creatine Powder



Micronized Creatine Powder



Creatine Capsules



Liquid Creatine

Click the link down below to learn more about creatine!

https://www.youtube.com/watch?v=0Hfz0_urSBk

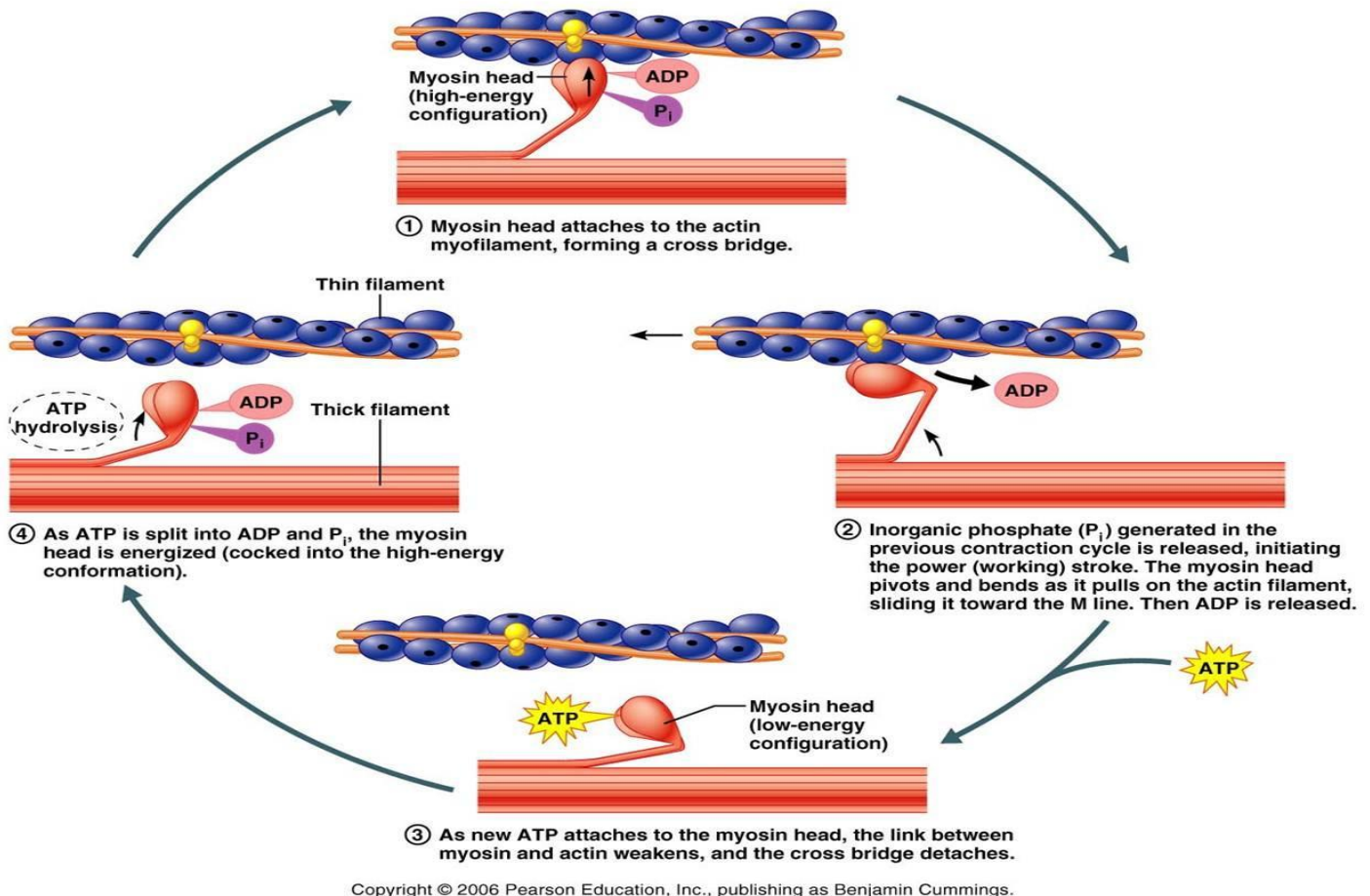


Figure 1. Shows the cross-bridge cycling mechanism in skeletal muscle. Creatine effects this cycle by changing the availability of the energy currency in the skeletal muscle.

The more a muscle works, the more cross-bridge cycling that needs to occur. Thus, the increased need for ATP. As skeletal muscle works harder and harder, the cells that produce and store ATP become depleted. The cross-bridge cycling mechanism needs and abundance of ATP to keep working, and if there isn't adequate energy, the muscle becomes fatigued. Creatine comes into

play at the beginning of exercise, or during non-aerobic exercise.

At the onset of exercise, our body needs a way to supply the active muscles with energy without the presence of oxygen. One of the ways our body does this is by using creatine phosphate. Creatine phosphate is a high energy phosphate just like ATP, and can be used to supply the cross-bridge cycling

with ATP. Creatine is naturally made in the body in much smaller quantity compared to a creatine supplement. The natural creatine binds to phosphates to supply the skeletal muscle with energy. Creatine supplements increase the amount of creatine in the body, thus increasing the amount of creatine phosphates. Muscle biopsies taken from people who were given creatine supplementation showed an increase of $31 \pm 28\%$ of muscle free creatine (Jager et al. 2011). The researchers went on to show that the creatine supplementation also increased creatine storage in the body, which increases the amount of creatine phosphates that can be made in the body. This is not the only research done to show the performance enhancing effects of creatine.

Researchers have looked at the short-term and long-term supplementation of creatine to see how they affect performance. Starting with the short-term affects, researchers saw an increase in bench press reps, peak cycling power, maximal power, extended work period, reduced sprinting times, and much more. As for the long term affects, which weren't as

noticeable as the short-term, had shown some benefits. They saw an increase in total creatine and phosphocreatine content, maximal strength, increased exercise capacity, and increased training adaptations. Both short and long-term had a great impact on performance. The next question to ask would be if creatine affects non-trained or trained athletes more. The research done by Cibbs et. al helped answer this question.

Their research consisted of using already trained individuals to see the effect of creatine on performance. The participants used for the study were trained body builders. Each of them underwent screening to make sure they didn't use any other supplements during the study, and only use the supplements provided by the researchers. They were then tested for baseline measurements for bench press, squat, and cable pull down. Muscle biopsies were also taken for baseline measurement. Some of the participants were given a creatine supplement, and some were given a normal carbohydrate supplement to represent the control

group. All supplementations went by the basis of 1.5 grams per kilogram of body weight, and each participant was given a schedule to take the supplement throughout the day. The 26 participants trained for over 7 months before testing. The results showed each participant increased their max rep for each of the three exercises as compared to the control group. As for the muscle biopsy, the creatine group showed greater muscle hypertrophy, or increased size of muscle (Cribb et. Al, 2007). This study showed that creatine supplementation could be beneficial for not only untrained athletes, but trained athletes as well.

Overall, creatine supplementation could be very beneficial to a wide range of people. This supplement large potential to help athletes perform, and these supplements are gaining more popularity as the years go by. The next supplement to look at regarding performance would be colostrum.

Colostrum:

Doctor Daniel Clark and Kaye Wyatt, authors of *Colostrum: Life's first food: the Ultimate Anti-Aging, Weight Loss and Immune Supplement*, stated in their book, "The number one killer in the world today is immune disease." Diseases can only enter your body when your immune system has been compromised. Some diseases that can compromise your immune system include heart disease, infections, cancer, ulcers, diabetes, and aging. Your body should heal itself if your immune system is functioning properly. Known for its healing powers, colostrum can strengthen your immune system and protect you from these diseases. It is also known for its effectiveness in weight loss and muscle growth.

What exactly is Colostrum?

Considered to be life's first food for mammals, colostrum is a thin milky substance that is only produced during the early stages of feeding newborns. Once extracted from the cow, bovine colostrum is dried into a powder to make into supplements. These supplements contain rich

amounts of growth and immune factors, including insulin-like growth factor 1 (IGF-1) (Coleman, E., 2005).

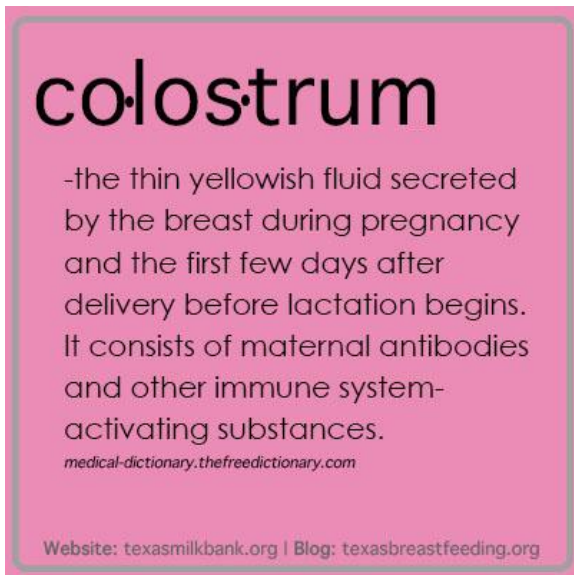


Figure 2. Definition of colostrum and its contents.

What makes up Colostrum?

Debatably the most complete food to exist, colostrum contains all essential fats, amino acids, and 87 growth factors. Growth factors are known to accelerate healing of the body and skeletal tissues such as in muscle, nerve, bone, and cartilage. All of the known immune factors are also found in colostrum; this helps protect against bacteria, viruses, and other invading organisms by strengthening the immune system (Clark & Wyatt, 1996).

Colostrum Biocompatibility

Just as type O-negative blood is considered the universal donor when it comes to blood transfusions, cows are the universal donor when it comes to colostrum. According to Clark and Wyatt (1996), bovine colostrum is used in the medical world in both humans and animals. It has the ability to reverse diseases because of identical growth factors that are common within all mammals. To this date the cow is the only animal to transfer these nutrients to humans and all other mammals.

Vaccines and Colostrum

To build immunity, colostrum was given before there were vaccines. A study was done in 2007 comparing colostrum to the flu vaccine. Conclusive results shown when it came to preventing the flu, colostrum revealed to be three times more effective than the flu vaccine (Cesarone et al., 2007).

Cancer Prevention

Mentioned previously, was how diseases can only enter your body when your immune system has been compromised. One of these examples was cancer.

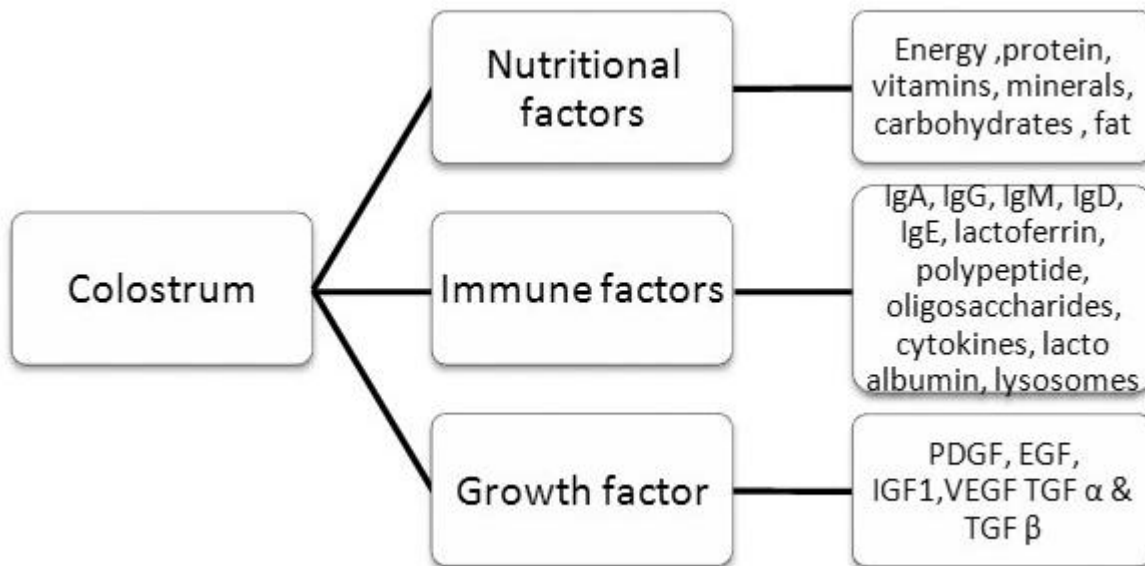


Figure 3. Contents that make up colostrum.

Cancer occurs when the immune system is not strong enough to fight back. Colostrum can prevent cancer from its immune boosting abilities. If cancer was all ready present, using colostrum would be beneficial to by boosting immune system functions and naturally fighting off cancer instead of the long and painful treatments (Mark & Wyatt, 1996).

Athletes and Colostrum

Colostrum has proven to be extremely beneficial to athletes. To show the athletic advantage when using colostrum, a study was done with soccer players and cyclists. Results found a 20% increase in strength, stamina, and a shorten recovery time (Coombes et al., 2002). Containing a similar version of insulin-like growth factor 1 (IGF-1) in humans, but this shortened IGF-1 is ten times more potent than the normal human IGF-1. As Daniel Shawn of Iron Man magazine wrote in 1992, “There is no other compound in the universe to date, which can help you better than IGF-1[:] not steroids, not biotechnology and its genetically engineered Growth Hormone, not releasing factors, not even a strict diet of pure amino acids and glycogen. Plain and simple, IGF-1 is the be-all and end-all of anabolic peptide growth factor.” More powerful than steroids, but

without the risks and side effects, bovine colostrum has been scientifically proven to increase muscle mass, performance, and energy.

Fat Burning

One and three Americans today are either overweight or obese and since obesity is linked to so many serious diseases, weight loss is critically important for health and self-esteem. Mentioned previously, colostrum contains all immune and growth factors; one of which being IGF-1. To help in muscle recovery IGF-1 stimulates tissue repair. It also helps in building lean muscle growth, increasing strength, and endurance. More importantly for some, IGF-1 stimulates your body's metabolism to burn fat for fuel.

Colostrum is categorized as a food, meaning there is no lethal dosage. To date, there has been no known side effects and can even be consumed by people who are lactose intolerant. The many benefits of colostrum are endless. People of all ages from infants to the elderly can benefit from colostrum.

Chromium:

Chromium is one of the five trace minerals with the other four being zinc, iron, copper, and selenium. By definition a trace mineral is a trace element required for nutrition with a quantity less than 100 mg per day. These five minerals: chromium, zinc, iron, copper, and selenium are often known as micronutrients. Different from macronutrients, micronutrients only play a small amount when it comes to nutrition. Even though chromium is considered a micronutrient it is essential in human nutrition (Williams et al., 2013).

Dietary Recommended Intake (DRI)

The Adequate Intake (AI) for chromium is 35 micrograms a day for men and 25 micrograms a day for women. Good sources of chromium include organ meats such as the liver, oysters, cheese, whole-grain products, asparagus, fruits, and even beer. Other ways to add chromium to your diet is by using stainless-steel cookware when cooking certain foods (Williams et al., 2013).

Major Functions

Chromium is essential when it comes to the insulin function as a glucose tolerance factor. In addition to maintaining blood glucose levels, it also helps in formation of glycogen in muscle tissue (Williams et al., 2013). William W. Edwards and his team in 2012 wanted to study the effects of chromium picolinate supplements on division I intercollegiate female swimmers' during the season. According to Williams et al. (2013), "Picolinate is a natural derivative tryptophan, an amino acid, and apparently facilitates the absorption of chromium into the body (p. 447)." 20 females swimmers agreed to take part of this study while 10 subjects received a placebo and the other 10 received chromium picolinate. This study ran over the course of the season (26 weeks) and at the end the female swimmers who took the chromium picolinate increased in fat-free mass and a decrease in overall percent body fat (Edwards et al., 2012).

As well as helping with blood glucose levels, and the formation of glycogen in muscle tissue, chromium supplementation was found to improve

cognitive-cerebral function in older adults. This 12 week study took 26 older adults with mild cognitive impairment and early Alzheimer's disease and randomly assigned them to receive a placebo or chromium picolinate supplement. The authors concluded that even though learning rate and retention did not improve with chromium picolinate, nevertheless, a reduction in semantic interference was found in learning and memory tasks (Krikorian et al., 2010). This supports their claim that chromium supplementation improves cognitive-cerebral function in older adults who suffer from some brain disease.

Consuming chromium supplement should never exceed over 200 micrograms a day. At that amount, chromium is considered dangerous if taken continuously day-after-day and not considered beneficial toward your health. Foods such as, whole grains, fruits, and vegetables are the best sources of chromium and should be considered first before a supplement.

Conclusion:

Supplements are becoming more and more popular in today's society. People today have resorted to taking a single pill to fix their problem. This mind set has helped increase the popularity of supplements. With popularity comes variety. The increased use of supplements has caused many new supplements to develop over a short period of time. These include the selected supplements discussed above. However, these supplements have fallen into a specific category: performance enhancing. The goal of this project was to see how these supplements affected athletic performance. Based on the findings, all three of these supplements have the potential to increase performance. With all of these supplements being over the counter, purchasing them is no harder than going to a supplement store like GNC. The NCAA should maybe give a look into these supplements when deciding to ban supplements from sports.

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