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The Think Muscle Newsletter publishes the latest news and research on exercise physiology, dietary supplements, performance enhancement, lifestyle management, health & nutrition, and bodybuilding & fitness. The newsletter is dedicated to providing accurate and unbiased scientifically based information.

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Message from ThinkMuscle:

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Introducing the launch of the official Hypertrophy-Specific website! Bryan Haycock, editor in chief of ThinkMuscle, author and founder of the Hypertrophy-Specific Training (HST) method and Hypertrophy-Specific Nutrition (HSN), now has a new website up to be a home for HST and HSN. This is the culmination of Bryan's years in the industry and culture/sport of bodybuilding.

Bryan began lifting weights in 1978. Over the last 23 years he has incorporated his passion for bodybuilding into his education as a physiologist and career as a writer and consultant for the sport supplement industry.

In 1998 Bryan was invited to write and work as editor-in-chief for the online magazine Mesomorphosis, founded by Millard Baker. The magazine experienced rapid growth in popularity and set a new standard for scientific accuracy in fitness publications. In July 2000, Mesomorphosis changed its name to ThinkMuscle. With the new name, ThinkMuscle began offering a newsletter that, through word of mouth, has grown to nearly 25,000 enthusiastic subscribers in only two years. With Bryan in the editorial driver's seat, ThinkMuscle has grown to world-renowned status. In 2001 EAS™, the second largest sports supplement company in the industry declared ThinkMuscle as "one of the great destination sites of the industry² and advised readers to be able to recognize the name "Bryan Haycock" as he "produce[s] some of the best information this industry has to offer." Currently, nearly 2,000 new subscribers sign up for the newsletter each month.

In October of 2000, Bryan wrote a short unassuming article describing a method of training that research had indicated would lead to the greatest degree of muscle growth. He called it Hypertrophy-Specific Training. Although he and his clients had been using this method for sometime, he had never shared it publicly. Slowly, after publishing the article in the ThinkMuscle newsletter, people began to apply HST to their own training, and the mail started flooding in.

In late 2001, frustrated with currently available supplements, Bryan recognized the opportunity to better meet the needs of his peers working professionally in the health/fitness industry by creating a line of ultra high quality products that could be used by him and other professionals. Seeing the consumers' growing distrust of supplement companies and their aggressive marketing, he decided to extend the availability of his exclusive line to ThinkMuscle readers.

www.Hypertrophy-Specific.com will allow Bryan to discuss HST and HSN freely without threatening the unbiased nature of ThinkMuscle and the newsletter.

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Protein, Part 1 - Definitions and Technical Background

by Lyle McDonald, CSCS

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If you ask 10 bodybuilders what the most important nutrient is for putting on muscle, you will most likely get 10 identical answers (a rarity in sports nutrition). That answer is, of course: PROTEIN! Every bodybuilder knows that, no matter what else you do, if you aren't getting enough protein, you won't grow.

Unfortunately, the obsession that bodybuilders have with protein has made them susceptible to all kinds of marketing hype. Whether it involves protein intake, quality, type, form, etc., marketing types know how to push a bodybuilder's buttons when it comes to protein.

If you want to sell a lot of protein powder, just throw around terms like 'nitrogen balance/retention', 'biological value' or 'anti-catabolic' and the money will start rolling in. If you want to scare bodybuilders into listening to you, start talking about amino acid oxidation (burning) with high protein intakes and how 'horrible' it is (too bad sarcasm doesn't carry to the written word). Then move in for the kill and sell them your product.
Like most aspects of bodybuilding (and the supplement industry in general), the issue of protein is driven more by marketing hype than physiological reality. The purpose of this article series is to address some technical issues regarding protein and to clear up some of the major misconceptions that currently exist. Although some of the information is decidedly technical, I will try to avoid unnecessarily nasty details as much as possible.
This first part will deal primarily with some definitions and technical background, so that later information will make more sense. In part 2, protein quality as well as a simplified model of amino acid metabolism will be developed. This will help readers to understand the discussion of adaptation to both high and low protein intake, as well as varying calorie levels. Although a discussion of every amino acid is beyond the scope of this article series, specific amino acids such as glutamine, luecine and alanine will be discussed as necessary.

Full text:

http://www.thinkmuscle.com/articles/mcdonald/protein-01.htm

Pre- and Post-workout nutrition to maximize the training Effect.

Introducing the first installment of the Hypertrophy-Specific Nutrition series.
by Bryan Haycock
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When implemented properly and consistently, strategic pre- and post-workout supplementation can greatly increase the effectiveness of your training. Without optimum nutritional strategies, the body's response to training can only be considered a compromise at best. From this perspective, training and diet can not be considered as separate factors. The food and supplements that you take, and the work that you faithfully perform in the gym, are both part of your training. On the day of competition it will not be the athlete who trained harder who wins, it will be the athlete who trained smarter.

Exercise causes acute changes in the metabolic environment of muscle tissue. First there is a significant increase in blood flow to working muscles. There is also a sharp increase in catecholamines (e.g. noradrenalin, adrenalin). These changes favor catabolism during exercise, and anabolism immediately after exercise. Because these changes are acute, some lasting only a few hours, the pre and post exercise meals are critical to optimizing the anabolic effect of

exercise. This article will discuss pre- and post-exercise nutritional strategies based on current research in this area.

BEFORE

Pre-workout nutritional strategies are based on providing alternative energy substrates (mainly carbohydrate) to preserve energy stores, and taking advantage of increased blood flow to muscle tissue.

Carbohydrates

High intensity exercise places great demand on glycogen stores. Glycogen is the sugar stored in the liver and muscles. Because high intensity exercise burns energy at such a high rate, the body is unable to supply sufficient oxygen to be able to use fat for fuel. Instead, it must use sugar both stored in the muscle and brought in from the blood.

Consuming simple sugars right before training can reduce the amount of glycogen used during exercise. This can prolong performance. More importantly, higher glycogen and insulin levels appears to create a hormonal milieu favorable to anabolism (growth).

During exercise, cortisol accelerates lipolysis, ketogenesis, and proteolysis (protein breakdown). This happens in order to provide additional fuel substrates for continued exercise. The effects of cortisol may also be necessary to provide an amino acid pool from which the muscle can rebuild new contractile proteins if there are insufficient amino acids delivered from the blood. This ensures that some degree of adaptation can occur regardless of the availability of dietary protein. Over time however, if this process is not balanced with additional dietary protein, the net effect will be only maintenance or even a decrease in functional muscle tissue, as is evident during periods of starvation or prolonged dieting. Fortunately, there is only a non-significant rise in cortisol levels when carbohydrates were consumed during exercise. (Tarpenning, 1998) The net effect is a more rapid increase in the cross sectional area of the muscle fibers with the greatest effect seen in type-II fibers.

This may be a less expensive option for those who were thinking of using phosphatidylserine. In this case, carbohydrate administration appears to down regulate the hypothalamic-pituitary-adrenal axis, probably through insulin or perhaps through the presence of carbohydrate itself. This would, in effect, greatly reduce the body's catabolic response to exercise stress. All good news for bodybuilders.

Protein

Another pre-workout strategy involves taking advantage of increased blood flow to working muscles. Because the availability of amino acids is often the limiting factor for protein synthesis, a pre-workout protein meal will enhance the delivery of amino acids to muscle tissue. Research has demonstrated the effectiveness of a pre-workout protein drink.

Delivery of amino acids has been shown to be significantly greater during the exercise bout when consumed pre-workout than after exercise (Tipton, 2001). There is also a significant difference in amino acid delivery in the 1st h after exercise, with the pre-exercise protein drink providing a significant advantage. Net amino acid uptake across the muscle is twice as high with

a pre-workout protein drink as compared to consuming it after. Phenylalanine disappearance rate, an indicator of muscle protein synthesis from blood amino acids, was significantly higher when amino acids were taken pre-workout. These results indicate that the response of net muscle protein synthesis to consumption of a protein solution immediately before resistance exercise is greater than when the solution is consumed after exercise. This is primarily because of an increased delivery of amino acids to the muscle.

AFTER
During exercise muscles use metabolic fuels at an accelerated rate. In order for physical work to be continuous, the body mobilizes stored fuels to make fatty acids, glucose, and amino acids available for oxidation. This is a catabolic process and cannot occur simultaneous to anabolic processes such as glycogen formation and protein synthesis.

In order for the body to recover from exercise, the catabolic environment must be quickly changed to an anabolic environment. The food that you eat after training effects the hormonal milieu in your body in order for this to take place. With the rapid introduction of carbohydrate, protein, and fat into the system post exercise, the body is able to begin reparations on damaged tissue and replenish fuel reserves.

Carbohydrates
Carbohydrates are important for performance and perhaps more importantly for glycogen recovery. Studies have shown an increased ability of muscle tissue to take up serum glucose immediately following strenuous exercise (Goodyear 1998). This is due to what is called, "non-insulin dependent glucose uptake". After a meal, muscle cells transport glucose across the cell membrane in response to the hormone insulin. Insulin binds with its receptors at the cell surface causing a cascade of events that ends with proteins, called glucose transporters, being translocated to the cell surface. Once at the cell surface, these glucose transporters allow glucose to pass through the membrane where they can be phosphorylated and eventually stored as glycogen.

Membrane transport of glucose will exhibit saturation kinetics similar to the effect of increasing substrate concentration on the activity of enzymes. The rate of glucose entry into your muscle cells is limited by the number of glucose transporters. Once all available glucose transporters are associated with a glucose molecule, the rate of glucose entry will go no higher.

There are at least 5 different classes of glucose transporter proteins. They are designated GLUT1, GLUT2, GLUT3, GLUT4, and GLUT5. Each class of GLUT protein differs in its kinetic parameters and are found in specific tissues. GLUT-4 is the primary isoform regulated by insulin, and sensitive to muscle contraction.

Muscle contractions, much like insulin, cause a separate set of GLUT-4 proteins to be temporarily translocated to the surface of the muscle cell (Sherman 1996). This greatly increases the rate at which muscle tissue can take in glucose from the blood after a bout of exercise. The effects of exercise on glucose uptake lasts for a few hours into the post exercise period. If the post exercise meal is lacking in carbohydrates, the replenishment of glycogen is delayed. If

carbohydrates are lacking in the diet, exercise will cause a glucose deficit and glycogen stores will continue to fall without being replenished to pre exercise levels.

There has been some controversy about which type of carbohydrate is best for post exercise glycogen replenishment. Some argue that simple sugars such as dextrose are best after exercise. Others say that drinks with glucose polymers are best. Still others say that there is no need to buy fancy sports drinks and that simply eating a meal high in carbohydrates such as pasta or rice is sufficient. Studies have shown no difference between different types of carbohydrates eaten post exercise and the rate of glycogen replenishment as long as sufficient quantities of carbohydrate are consumed (Burke 1997). Even when the post exercise meal contains other macronutrients such as proteins and fats, the rate of glycogen replenishment is not hindered, given there is sufficient carbohydrate in the meal as well. These studies tell us that the rate-limiting step in glycogen replenishment after exercise is not in digestion or the glycemic index of a given source of carbohydrate. Over a 24 hour period it is the total amount of carbohydrate consumed that is important.

The rate-limiting step in glucose uptake during exercise is determined by the rate of phosphorylation once glucose has entered the muscle cell (Halseth 1998). Glycogen synthase activity is also a possible rate-limiting step (Halseth 1998). These processes are not readily influenced by the composition of the "post exercise" meal, but rather by the extent to which glycogen was depleted during exercise as well as the amount of carbohydrate and fat consistently included in the diet.

It is recommended that at least 0.7 - 1.0 gram of carbohydrate per kilogram body weight be consumed immediately after exercise and then again 1-2 hours later. If you experience gastric upset try increasing the amount of water you consume with the carbs. Try to shoot for a total of 7-10 grams of carbohydrate per kilogram of body weight over a 24 hour period 3 for maximum glycogen storage. This may well be in excess of caloric needs but it is important to shoot for this intake if glycogen storage is your primary goal.

Protein

Protein is another critical nutrient post-exercise. Protein is essential to post exercise anabolism. Protein provides amino acids which are used to rebuild damaged tissues as well as provide enzymes and carrier proteins necessary for adaptation to exercise. Without protein, which supplies essential amino acids for endogenous protein synthesis, the body’s ability to adapt to exercise is greatly diminished.

Studies have shown a 12 to 14 day period after the onset of an unaccustomed exercise program, in which nitrogen balance, the ratio of protein intake to protein loss, is negative (Butterfield 1987). Any study looking at protein needs and exercise must take this into account. Nitrogen balance during this period appears to be insensitive to total caloric intake, but can be improved with a high protein intake if adequate calories are supplied (Gontzea 1975). Even though additional protein intake will prevent nitrogen balance from becoming negative, it will still fall despite high protein intake during the first two weeks of exercise.

Muscle specific messenger RNA (mRNA) produced subsequent to training has a half life of only 4-5 hours. It is so short because mRNA has no "quality control" mechanism built into the coding. By keeping the half life short, any errors in the sequence won't be able to produce enough defective proteins to do irreparable damage to the cell or organism. This also allows tight control of protein metabolism.

The timing of protein intake is important. If the anabolic stimulus from exercise is to be maximized, a steady flow of amino acids must bathe the muscle while mRNA content is high. It should be no surprise that the optimum time for protein intake after your workout is relatively brief compared to frequency of training a particular muscle. Muscle protein synthetic rate (MPS) is elevated in humans by up to 50% at about 4 hours following a bout of heavy resistance training, and by 109% at 24 hours following training. A study done by Macdougall (MacDougall et al 1995) further examined the time course for elevated muscle protein synthesis by examining its rate at 36 hrs following a bout of heavy resistance training. Six healthy young men performed 12 sets of 6- to 12-RM elbow flexion exercises with one arm while the opposite arm served as a control. MPS was calculated from the in vivo rate of incorporation of L-[1,2-13C2] leucine into biceps brachii of both arms over 11 hours. At an average time of 36 hours post-exercise, MPS in the exercised arm had returned to within 14% of the control arm value, the difference being nonsignificant. The following conclusions can be drawn from this study, following a bout of heavy resistance training, muscle protein synthetic rate increases rapidly, is more than double at 24 hours, and then declines rapidly so that at 36 hours it has almost returned to baseline.

Current recommendations for total protein intake for athletes is between 1.6-1.8 grams per kilogram body weight, depending on who you read, however, it is not uncommon for bodybuilders to consume in excess of 2 grams per kg of body weight with no ill effects. It should be remembered that the body does not have the capacity to effectively store amino acids. Protein should be eaten at least every 3-4 hours. The evening meal should contain slowly digesting protein that will allow a steady release of amino acids into your system well into the night. Dinner is a perfect time for steak or other meat dishes.

Fat

Little is known about the effects of fat in the "post-exercise" meal. Total fat intake is probably more important for a bodybuilder than just considering the post-workout meal.

Essential fatty acids in sufficient quantities have the ability to alter physiology. Fatty acids such as omega-3s' and omega-6s', when consumed in differing ratios in a consistent and deliberate manner, can alter the composition of cell membranes which alters the production of prostaglandins in working muscles and thereby can modify everything from glucose transport to protein synthesis (Hayashi 1999). These effects are seen after at least 5 days of consuming of these fats in moderate to high doses. Eating them immediately after training and at no other time will most likely not have any dramatic effect.

Some forms of fat may delay gastric emptying which theoretically could slow the rate at which nutrients become available to tissues. We can only speculate whether this would have any "long term" effect on gains. Most research indicates that glycogen replenishment is delayed but not reduced when gastric emptying is prolonged.

There is some indication that cholesterol may be an important nutrient immediately after high intensity resistance exercise. Total cholesterol has been shown to be significantly lowered for at least 90 hours following a single bout of resistance exercise (Smith 1994). Serum cholesterol may be needed for incorporation into damaged cell membranes after resistance exercise. I'm not implying that you should eat a high cholesterol meal right after training. Taken together, research is still lacking where the optimal levels and composition of post-exercise fats are concerned.

Fluids

I couldn't really write an article about pre- and post exercise nutrition without at least mentioning fluid replacement. Hydration is extremely important on the cellular level. Muscle growth is inhibited by dehydration. In bodybuilding we tend not to focus on fluid replacement because, unlike runners or cyclists, most bodybuilders do not become dehydrated after a single workout. The rate at which you become dehydrated from training depends on how much you sweat (Gisolfi 1990). Some people sweat a lot when lifting and others don't sweat a drop. A good rule of thumb is to drink 1 ml for every calorie that you need. So, if you eat 3,500 calories a day, try to drink 3 ½ liters. If you exercise in hot or humid climates add 2 cups of water for every pound you lose while exercising.

It's about synergy

As mentioned earlier, macronutrient intake modulates post-exercise protein synthesis in ways that are just beginning to be understood. Yes, protein is required to supply essential amino acids for protein synthesis, but what is the mechanism by which protein is controlling this process? Also, are carbohydrates and fats needed only for fuel replacement, or do they play an "interactive" role in post exercise protein synthesis? Recent research has shed light on these questions.

Researchers from the Division of Nutritional Sciences at the University of Illinois examined the effect of post exercise meal composition on protein synthesis. To do this, they looked specifically at the activity of specific proteins known to regulate protein synthesis at the translational level.

Initiation of translation (the binding of mRNA to the ribosomal pre-initiation complex) requires group 4 eukaryotic initiation factors (eIFs). These initiation factors interact with the mRNA in such a way that makes translation (the construction of new proteins from the mRNA strand) possible. Two eIFs, called eIF4A and eIF4B, act in concert to unwind the mRNA strand. Another one called eIF4E binds to what is called the "cap region" and is important for controlling which mRNA strands are translated and also for stabilization of the mRNA strand. Finally, eIF4G is a large polypeptide that acts as a scaffold or framework around which all of these initiation factors and the mRNA and ribosome can be kept in place and proper orientation for translation.

The researchers in this study looked at the association of the mRNA cap binding protein eukaryotic initiation factor-4-E (eIF4E) with the translational inhibitor 4E-eukaryotic initiation factor binding protein-1 (4E-BP1) in the acute modulation of skeletal muscle protein synthesis during recovery from exercise. Fasting male rats were run on a treadmill for 2 h at 26 m/min and were fed immediately after exercise with either saline, a carbohydrate-only meal, or a

nutritionally complete meal using Ensure Powder (54.5% carbohydrate, 14% protein, and 31.5% fat). Exercised animals and non-exercised controls were studied 1 h post-exercise.

Muscle protein synthesis decreased 26% after exercise and was associated with a fourfold increase in the amount of eIF4E present in the inactive eIF4E.4E-BP1 complex and a concomitant 71% decrease in the association of eIF4E with eIF4G. Refeeding the complete meal, but not the carbohydrate meal, increased muscle protein synthesis equal to controls, despite similar plasma concentrations of insulin. Additionally, eIF4E.4E-BP1 association was inversely related and eIF4E.eIF4G association was positively correlated to muscle protein synthesis. This study demonstrates that recovery of muscle protein synthesis after exercise is related to the availability of eIF4E for 48S ribosomal complex formation, and post-exercise meal composition influences recovery via modulation of translation initiation.

The results of this study tell us a few things:

1. Insulin (via carbohydrate intake) alone is not enough to prevent 4E-BP1 from sequestering eIF4E. EIF4E must be free to bind to eIF4G in order for protein synthesis (i.e. recovery from training and net muscle growth) to begin. Insulin as well as amino acids must be present at the same time as indicated by the results from the group that were fed a mixed nutrient meal. So although feeding of the carbohydrate meal resulted in elevated blood glucose and elevated insulin levels, carbohydrates alone are not sufficient to allow protein synthesis to begin.

2. The only group that experienced a significant drop in cortisol levels was the mixed meal group. The carbohydrate-only group showed that neither blood glucose nor insulin had any effect on reducing cortisol levels. In contrast, the mixed meal group showed cortisol levels even below those in the control group who did no exercise and were also fed the same meal.

It would have been nice for the authors of this experiment to have explored the effect of the fat content in the "mixed meal". From the results we saw that cortisol was lower in the mixed meal group. We can only speculate whether this was due to the protein, the fat, or some combination of protein, fat and carbs. Further research in this area should take into consideration all components of the post exercise meal. One other issue that might be addressed in humans is the time frame during which re-alimentation is critical to "long term" adaptation to exercise.

In closing...
Pre- and post-exercise nutrition is critical if one wants to maximize the anabolic effects of exercise. The pre-exercise meal should be high in a quickly digestible protein. This will ensure high delivery of amino acids to the muscle tissue. Carbohydrates can also be taken to minimize glycogen loss and suppress catabolic hormones. Fat should be avoided pre-exercise unless the exercise is for endurance.

The post exercise meal should consist of carbohydrate, protein and perhaps a small amount of essential fats, in a form that is easily and quickly digestible. There are many meal replacement products that fit the bill. Just pick the one you like the most. Don’t worry about sugar content because right after a workout, fat storage is not a big issue. A liquid meal is the most practical method of post-exercise feeding although it is probably not essential. The ratio of macronutrients

depends somewhat on the nature of the training session. An emphasis on high glycemic carbs, complete readily digestible proteins such as whey, egg, or high quality casein, and essential fats such as fish or flax oil will meet the criteria for an effective post exercise meal.

References

Burke LM. Nutrition for post-exercise recovery. Aust J Sci Med Sport Mar;29(1):3-10, 1997

Butterfield GE, Whole-body protein utilization in humans. Med. Sci. Sports Exrc., Vol. 19, No. 5 (Supplement), pp. S157-S165, 1987.

Gisolfi CV., Lamb DRR. (Eds.) Perspectives In Exercise Science and Sports Medicine Volume 3: Fluid Homeostasis During Exercise. Cooper Publishing Group, LLC 1990.

Gontzea I, Sutzescu P, Dumitrache S. The influence of adaptation to physical effort on nitrogen balance in man. Nutr. Rept. Inturn. 11:231-236, 1975

Goodyear LJ, Kahn BB, Exercise, glucose transport, and insulin sensitivity. Annu. Rev. Med. 49:235-261, 1998

Halseth AE, Bracy DP, Wasserman DH. Limitations to exercise- and maximal insulin-stimulated muscle glucose uptake. J. Appl. Physiol. 85(6):2305-2313, 1998

Hayashi N, Tashiro T, Yamamori H, Takagi K, Morishima Y, Otsubo Y, Sugiura T,

Furukawa K, Nitta H, Nakajima N, Suzuki N, Ito I Effect of intravenous omega-6 and omega-3 fat emulsions on nitrogen retention and protein kinetics in burned rats. Nutrition 1999 Feb;15(2):135-9

MacDougall JD, Gibala MJ, Tarnopolsky MA, MacDonald JR, Interisano SA,

Yarasheski KE The time course for elevated muscle protein synthesis following heavy resistance exercise. Can J Appl Physiol 1995 Dec;20(4):480-6

Sherman LA, Hirshman MF, Cormont M, Le Marchand-Brustel Y, Goodyear LJ. Different effects of insulin and exercise on Rab4 distribution in rat skeletal muscle. Endocrinology 137:266-73, 1996

Smith L.L, Fulmer M.G, Holbert D, McCammon M.R, Houmard J.A, Frazer D.D, Nsien E, and Isreal R.G. The impact of a repeated bout of eccentric exercise on muscular strength, muscle soreness and creatine kinase. Br. J. Sports Med.1994; 28 (4) 267-271.

Tarpenning KM, Wiswell RA, Marcell TJ, Hawkins SA. Influence of Weight Training Exercise and Modification of Hormonal Response on Skeletal Muscle Growth.
Medicine & Science in Sports & Exercise. 1998 May;30(5) Supplement; S1-S1339

Tipton KD, Rasmussen BB, Miller SL, Wolf SE, Owens-Stovall SK, Petrini BE,
Wolfe RR. Timing of amino acid-carbohydrate ingestion alters anabolic response of muscle to resistance exercise. Am J Physiol Endocrinol Metab. 2001 Aug;281(2):E197-206.

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Supplement Fact & Fiction : Tribulus Terrestris

by Bryan Haycock

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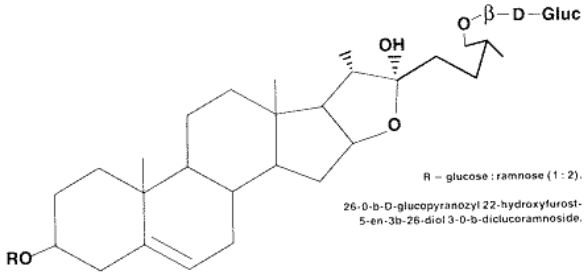
In the pursuit of wealth, many supplement companies make fraudulent claims about what their product can do for you. Often these claims are based on misrepresented science, shoddy science, or no science at all. This column exists to offer the consumer some protection from fraudulent supplement companies as well as direct your attention to supplements that really do offer some benefit. The information presented here will be based entirely on data collected in controlled experimental conditions. Anecdotal evidence will be considered, but not relied upon to support the manufacturer's claims.

Tribulus Terrestris extract

I first read of a tribulus terrestris product called Tribestan®, which I believe was the first tribulus terrestris product marketed to the public, in Dan Duchaine's *Underground Steroid Handbook*. Since that time I have accumulated mostly second hand accounts of how, and how well, it works. Though the research is questionable, products containing tribulus terrestris continue to sell very well.

Tribulus is an herbal supplement used since the late 70's in Eastern Europe. Its purported effects include increased luteinizing hormone release, and thus testosterone production, increased sperm production, increased ejaculatory volume, and increased libido. In young patients with a condition known as hypogonadism, an increase in pubic hair has also been observed. All of these effects make tribulus an interesting supplement indeed.



I should tell you at the onset that very little research has been done on tribulus outside of Eastern Europe, let alone without some association with a Bulgarian company called Sopharma. This makes getting access to independent studies in English very difficult because they are virtually non-existent. Most of the information I will use is provided by Sopharma of Bulgaria. Many of you know that this is the company the manufactures Tribestan®. This does not mean the data is necessarily false, it simply needs to be kept in mind when interpreting the data. Much of their

research on tribulus terrestris was used to get patent approval as well as to get the product registered for distribution in the United States.

So why is there so little research done on herbal preparations with medicinal purposes here in the US? For those of you not from the U.S. or not familiar with the "American Medical Model" I will *briefly* explain. Here in the U.S. we practice what is sometimes called "rescue medicine". This refers to the fact that we put the overwhelming majority of our funds and man-hours into discovering ways to save people from the brink of death. Regardless of what you hear on the morning news, there is only a minute percentage of federal moneys spent on exploring preventative medicine. We claim bragging rights to a considerable number of medical innovations all designed to cheat fate (A.K.A. death). If nature has dealt you a bad hand you can count on the American Medical Association to do everything in their Hippocratic power to slip you an Ace or two under the operating table. More often than not this simply prolongs the suffering of the sick as they "enjoy" the sometimes involuntary treatment from medical doctors.

Recently there has been a push from the public to explore more holistic approaches to health. The popularity of "alternative medicine" has been growing every year for the past decade or more. Where are we getting this alternative medicine? From countries in Eastern Europe, the Middle East, and of course the Far East. In countries such as China, Bulgaria and the former Soviet Union plants with medicinal properties are taken very seriously. Scientists involved in this research are just as respected as those involved in more traditional "western" medicine, unlike here in the U.S. where they are often labeled as quacks. OK, time to step down form my soapbox. Let me finish by saying that things are changing here in the U.S. and I wouldn't be surprised to see a dramatic paradigm shift in the next couple of years as herbal medicine shows itself profitable to pharmaceutical companies. After all, where do you think the exorbitant amounts of money spent on health care go? That's right, into the pockets of those working in the health care and pharmaceutical industry.

The original purpose for tribulus terrestris extract was as a "tonic" to treat sexual dysfunction. In animal husbandry studies tribulus extract was shown to stimulate rutting behavior (i.e. attempting to score) in rams as well as boars. When the supplement Tribestan® was given to healthy men (Milanov, 1981) in a dose of 750 milligrams per day for five days, LH and testosterone were elevated 72% and 40% respectively. As you might expect, estradiol was also elevated. In fact estradiol was elevated by 81%! The increase in testosterone is obviously what all the fuss is about, nevertheless, you can't ignore the fact that whenever you increase testosterone you are going to increase aromatization and therefor estrogen levels. To put these changes in hormone levels into perspective, the reference range for testosterone in men is between 300 - 1,000 ng/dL. The subjects in this study started out with an average of 600 ng/dL and ended up with about 850 ng/dL. This is still well within the "normal" range for men. Estradiol on the other hand went from normal levels of about 76 pg/ml to significantly elevated levels of 137.5 pg/ml. This is well above normal levels which range from about 20-80 pg/ml in men.

So why haven't people been reporting symptoms of elevated estrogens like bloating and gyno from the use of tribulus products? My first response would be to say because they are not actually experiencing elevated estradiol levels due to the poor quality of most tribulus terrestris

supplements. Lab tests (paid for by Sopharma) on several manufacturers of raw tribulus terrestris extract show that the majority don't contain sufficient levels of protodioscine. Sopharma also went on to test various supplements said to contain tribulus terrestris extract and found most all of them to contain *far* less than that found in Tribestan®. Another important issue to point out is that tribulus terrestris as an herbal supplement is not the same thing as tribulus terrestris *extract*. Plain tribulus terrestris looks like any other herb that has been chopped up finely and dried, no different than the dried herbs you buy to cook with (Fig. 1). Tribulus terrestris *extract* looks much different. It is a reddish brown powder (Fig. 2).

According to the manufacturers, tribulus "extract" is extremely safe and appears to have no undesirable side effects. One of the reasons Tribulus extract doesn't seem to have any apparent side effects in research subjects is because it doesn't push testosterone above "upper" normal levels. The body is seemingly up-regulating aromatization to accommodate for the increase in LH and testosterone. No studies have been done to date to support this but from the changes in testosterone and estradiol respectively I would say there is a good chance this is in fact what is happening.

So to get the most out of tribulus extract I would suggest that you make sure you are in fact taking tribulus terrestris *extract*. Now that you know what it looks like you should have no problem finding a product that at least appears to be genuine. Although Chrysin has not exactly performed as expected, if you take enough of it you should be able to reduce the amount of aromatization caused by tribulus extract and hopefully increase testosterone levels slightly more. 1.5 -2 grams per day is a good place to *start* with Chrysin. Obviously an aromatase inhibitor like Arimidex would be perfect if you have access to it. ½ tablet per day would be sufficient for the first week, then ½ tablet every other day for the duration of time using tribulus extract should be enough. You don't want to completely inhibit aromatase because that will lead to a reduction in GH and IGF-1 levels. As a rule of thumb take as little Arimidex as you need to control symptoms.

Prohormones such as androdiol, norandrodiol, and 1-AD should theoretically also be helpful when taking tribulus extract. To be more precise, tribulus should help prevent or postpone the reduction of LH caused by chronic prohormone intake. I am also assuming that you would be using prohormones to elevate testosterone levels not just to "help" your workouts. This usually requires higher doses of prohormones taken throughout the day and can be accompanied by the usual unwanted side effects. Keep in mind that we are talking about taking 750-1,500 milligrams of pure tribulus extract per day to be effective. Taking less will simply be a waste of money for most people. Upon discontinuation of the tribulus product you should taper your dose over a period of at least 2-3 weeks.

Summary of Tribulus terrestris extract

Compound:	**Tribulus terrestris extract** NOTE: The following comments and recommendations are valid only with respect to tribulus products containing tribulus terrestris extract standardized for at least 45% steroidal saponins of the furostanol type. Of these saponins protodioscine should predominate.
Reported Benefit:	Marketed as a "testosterone booster", claims include increased Luteinizing Hormone (LH) release and thus increased testosterone production. Unfortunately claims about

	tribulus products usually insinuate that you will get steroid-like effects from this product. *Even the most potent tribulus products will not approach the effectiveness of most synthetic androgens for building muscle.*
Have controlled studies been performed?	Yes, but most research was done in Eastern Europe and was sponsored/produced by Sopharma, a manufacturer of the product. Their research shows tribulus terrestris extract to have a significant effect by increasing LH (~72%), testosterone(~40%), and estradiol(~80%).
Mechanism of action:	Tribulus Terrestris extract has been shown to stimulate LH release from the pituitary gland. It may also have some peripheral effects as manifested by increased pubic hair in some hypogonadal test subjects. It is speculated that the metabolites of protodioscine may also have mild androgenic properties. The exact mechanisms are still vague and current explanations are speculative at best.
Interaction with other nutrients?	No
Effective dose:	Effective doses used in clinical settings are 750-1500 milligrams per day. NOTE: I refer to studies using Tribestan®. Other supplements with lower concentrations of active steroidal saponins would require larger doses to achieve the same effect.
Proper dosing schedule:	Take 3-4 times per day with meals. As the half-life of protodioscine is very low (~2 ½ hours), a more frequent dosing schedule *might* increase effectiveness. NOTE: In order to have an effect on male fertility supplementation must continue for at least 90 days.
Toxicity?	None demonstrated with "extract"
Conditions where may be effective:	May be most effective at correcting a decline in LH pulsatile amplitude and/or frequency. Should be effective at returning testosterone to "normal" levels in situations where testosterone is abnormally low such as in

	chronic or acute hypogonadism, after a steroid cycle, while overtraining, with age associated declines in testosterone, and during extreme and/or prolonged dieting. NOTE: Taking an aromatase inhibitor should significantly enhance the effectiveness of tribulus terrestris extract to elevate serum testosterone.

References for Tribulus terrestris extract:

Vankov, S. Apropos of Tribestan pharmacology. Scientific-technical Report, 1980.
Viktorov, Iv., D. Kaloyanov, Al. Lilov, L. Zlatanova, Vl., Kasabov. Clinical investigation on Tribestan in males with disorders in the sexual function MBI, 1982 (in print).
Gendjeiv, Z. Studies on Tribestan carcinogenicity. Scientific-technical report, 1981.
Koumanov, F., E. Bozadjieva, M. Andreeva, E. Platonova, V. Ankov. Clinical trial of Tribestan. Exper. Med. 1982, 2.
Milanov, S., E. Maleeva, M. Tashkov. Tribestan effect on the concentration of some hormones in the serum of healthy subjects (Company documentation)(1981).
Nikolov, R. Neuropharmacological Study on Tribestan. Scientific-technical report, 1981.
Protich, M., D. Tsvetkov, B. Nalbanski, R. Stanislavov, M. Katsarova. Clinical trial of Tribestan in infertile males. Scientific-technical Report, 1981.
Tanev, G., S. Zarkova, Toxicological studies on Tribestan. Scientific-technical Report, 1981.
Tomova, M., R. Gyulemetova, S. Zarkova. An agent for stimulation of sexual function. Patent (11) 27584 A61K35/1978.
Tomova, M., R. Gyulemetova, S. Zarkova - License (11) 27584 AGIR 35/1978.
Tomova, M., R. Gyulemetova, S. Zarkova at al., License 68428/18.I.1985.

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Best regards,

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