



Body-Building Nutrition

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Diet Facts, Fallacies and Strategies for Building Muscle and Burning Fat

by Jeffery Stout, Ph.D.

If the human body could list its top-10 most efficient processes, adaptation would probably rank number one. Evolution over millions of years has turned the species into a form that's geared not for the production of a slim waist or muscular arms, but for survival. In ages past, periods of famine were common. Yet the human race prevailed. The catch, unfortunately, is that those who have a considerable propensity to store fat survived. Thus, the 20th-century human is someone who has adapted to years of food shortages through a nauseating ability to maintain a pear-shaped torso. So much for survival of the fittest.

Consequently, when the innocent dieter initiates a restrictive diet, the body's response is to kick into survival mode. That, in essence, is a signal to store fat to offset an anticipated period of insufficient calorie intake. Compounding matters is a gradual decline of the body's metabolism, rendering the task of fat loss even more difficult.

The process is no different from any other the body performs when encountering change—it adapts. Instead of perceiving food as the culprit, you should view it as fuel. Food is fuel for an increasing metabolism, fuel for the release of fat-burning and muscle-building hormones and, finally, fuel for a healthy diet and a normal lifestyle. When you eat food in precise amounts, your body must adapt; however, it adapts to the notion that it will get the energy it needs. When it does, your body will respond with its own goodwill gesture, a liberation of its suddenly unnecessary fat stores.

Facts and Fallacies of Food

All food can be separated into three basic types: proteins, carbohydrates and fats. Together they form the basis of all diets and, along with exercise, ultimately determine changes in body composition.

You achieve such changes through hormonal release, an increase in metabolism and the preservation and enhancement of muscle tissue.

Proteins are considered the body's building blocks for muscular repair, maintenance and growth. Adequate protein intake ensures the preservation of muscle tissue and enhances recovery from both strenuous workouts and daily activities. Since exercise causes significant damage to muscular tissue and subsequent growth requires adequate recovery, protein is often the missing factor. If you don't take in enough protein, your muscle may not be spared and you'll experience appreciable decreases in metabolism.

Fallacy 1: The RDA for Protein Is Sufficient

The recommended dietary allowance, or RDA, for protein is approximately .36 grams per pound of bodyweight. Based on that, a 200-pound man would require a mere 72 grams of protein daily. That may be sufficient for a sedentary individual, but when you factor in strenuous activity such as endurance or weight training, the RDA is grossly inadequate. In fact, research studies have suggested that consuming the RDA for protein during periods of intense training may lead to loss of muscular tissue.^{1,2} It's apparent that protein requirements depend on an individual's activity level, to the extent that a range between .64 and .91 grams of protein per pound of bodyweight is appropriate.^{1,2}

The body's primary fuel for energy is derived from carbohydrates. They're especially important for aerobic activities and high-volume weight training and are also used during periods of recovery. As with protein, inadequate intake of carbohydrates can compromise exercise performance and duration; however, based on the recommendations of most dietitians, you might mistakenly believe

While many people believe that spare carbohydrates are in large part stored for energy, it's more likely that excess carbs will be converted to bodyfat.

that there are no perils involved in carbohydrate consumption.

Fallacy 2: The More Carbs the Better

Contrary to what's often uttered about the merits of carbohydrates, the fact remains that excess carbs lead to excess inches. With the exception of the overly lean individual who has a speedy metabolism, a situation in which weight gain is often the goal, overindulgence in high-carb foods can be as detrimental to waistlines as excess fat. While many people believe that spare carbohydrates are in large part stored for energy, it's more likely that excess carbs will be converted to bodyfat.³ Furthermore, studies have shown that subjects can achieve identical improvements in body composition, strength and muscular endurance with diets in which as little as 40 percent of the calories come from carbohydrates vs. those that contain more than 60 percent carb.^{4,5} Studies have also repeatedly demonstrated that the total calorie intake is the dominant factor in weight loss.^{6,7}

It's obvious that fats have endured more than their share of abuse. Saturated fats, in particular, are considered a key contributor to heart disease, an epidemic that's claimed more lives than the flood in Genesis. Fats also carry more than twice as many calories per gram as either carbohydrates or protein. Though it's true that an excessive fat intake is the best way to make yourself resemble a blimp, it's also a fact that fat is necessary for proper metabolic function, for hormone production and as an energy source.

Fallacy 3: Avoid Fat Entirely

Most American diets contain either too little or too much fat. Neither method is a successful tactic for weight loss. When examining what occurs with most restrictive diets, people assume that all dietary fat can only be deposited in adipose tissue. That's absurd. In reality the body uses dietary fat for energy when it's in a state of negative energy balance.⁸ As long as your total calorie intake is less than what you expend, the percentage of fat in the diet isn't as significant as was once thought. Studies have also affirmed that subjects can achieve equivalent differences in weight loss with diets consisting of approximately 10 to 50 percent fat, as long as the total calorie consumption is identical.^{6,7}

It's evident that the low-calorie, lowfat, high-carbohydrate diets that dietitians and others have been advocating for years are in fact fallacies. (More on the essential fats in Chapter 6.)

All Carbohydrates Are Not Created Equal

Now that you know to avoid excess carbohydrates, it's time to look at the type of carbs you should eat. Though all carbohydrates break down into glucose and are released into the bloodstream, the speed at which the process occurs varies drastically with different carbohydrates. The absorption rate is a critical factor in energy levels, fat reduction and overall health. Foods have been assigned a glycemic-index rating, a measure of how fast their carbohydrates enter the bloodstream to be used as energy or stored as glycogen, a preserved form of energy. High-glycemic foods are available quickly for use as energy; while that may seem optimal, in actuality they trigger a hormonal reaction that has reverse effects.

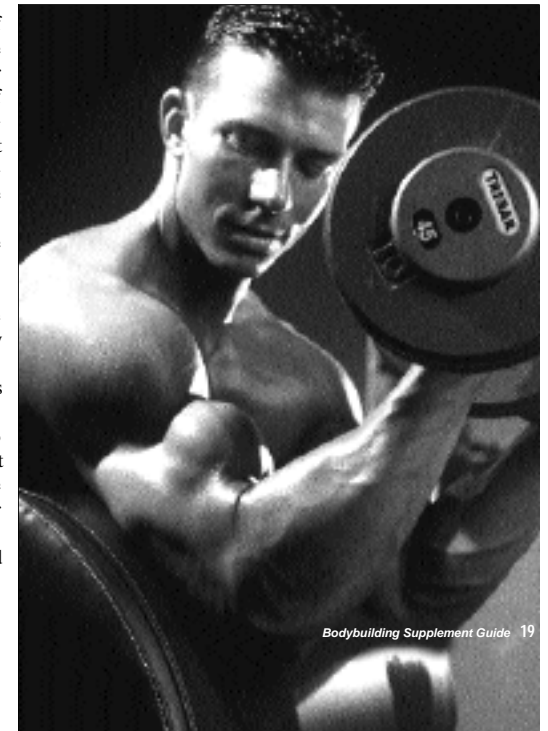
High-glycemic carbohydrates produce a rush of glucose into the bloodstream, elevating blood sugar levels dramatically. The sudden rise stimulates a release of the hormone insulin, which essentially negates the high-energy effects of glucose. The rapid release of insulin shuttles the glucose out of the bloodstream, effectively dropping energy levels to lethargic lows. To make matters worse, it also takes the fatty acid energy source with it, shoveling it into the fat cells for storage. High-glycemic foods, therefore, carry a double curse, keeping you fat and lazy.

While insulin promotes fat storage, growth hormone, or GH, effectively burns fat, builds muscle and improves the immune system.

Table 1: Glycemic-Index Rankings of Foods

(All foods are rated in comparison to white bread, which is scored 100)

High	Moderate	Low
Instant rice (128)	Ice cream (87)	Grapefruit juice (69)
Crispix cereal (124)	Cheese pizza (86)	Green peas (68)
Baked potato (121)	White rice (83)	Grapes (66)
Cornflakes cereal (119)	Popcorn (79)	Linguine (65)
Rice Krispies cereal (117)	Oatmeal cookies (79)	Macaroni (64)
Pretzels (116)	Brown rice (79)	Orange (63)
Total cereal (109)	Spaghetti, durum (78)	Peach (60)
Doughnut (108)	Sweet corn (78)	All-Bran cereal (60)
Watermelon (103)	Oat bran (78)	Spaghetti, white (59)
Bagel (103)	Sweet potato (77)	Apple juice (58)
Cream of Wheat (100)	Banana (77)	Apple (54)
Grapenuts cereal (96)	Special K cereal (77)	Vermicelli (50)
Nutri-grain bar (94)	Orange juice (74)	Barley (49)
Macaroni and cheese (92)	Cheese tortellini (71)	Fettucine (46)
Raisins (91)	Chocolate (70)	Lentils (41)



You should eat small meals throughout the day to maximize your metabolic response—and breakfast is the most important meal of the day, although the postworkout meal may be equally important.

In the past experts recommended that foods high in simple sugars—such as candy, cookies and soft drinks—be avoided for the aforementioned reasons. While that's true, many revered energy sources are also considered high-glycemic foods. Surprisingly, many kinds of pasta, rice and potatoes rank rather high on the glycemic index. Breads and cereals are also often offensive, fast enough to zap energy levels and hoard fat.

Fortunately, you can get the opposite results with low-glycemic foods. They provide more stable energy levels and a slower insulin response, favoring the probability of productive workouts and sustained vitality. Those foods rank in the below-70 category on the glycemic index chart (see Table 1).

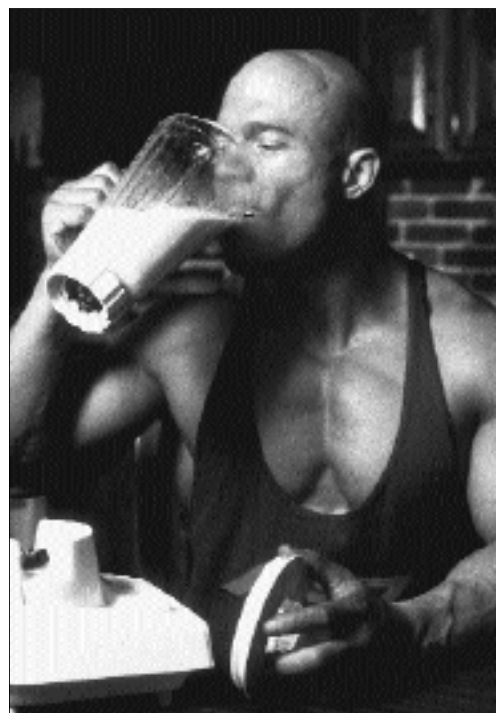
Since foods are usually eaten in combinations, the glycemic index of a meal is usually lower than the glycemic index of its highest constituent. For instance, if you combine equal calories from a bagel and an apple, the glycemic index of that meal becomes more acceptable.^{7,9} Protein also helps matters, as protein foods efficiently decrease the total glycemic index of what you're eating by slowing the absorption rate of the carbohydrates. That emphasizes the importance of combining protein and carbohydrates in each meal.

Food: A Potent Hormone Trigger

As discussed above, the hazards of one hormone, insulin, are encouraged when you eat high-glycemic foods. While insulin promotes fat storage, growth hormone, or GH, effectively burns fat, builds muscle and improves the immune system. That provides another advantage to low-glycemic foods. If you emphasize low-glycemic foods and stable blood sugar, you have a positive environment in which GH can exert its effects.^{6,3}

The actions of the muscle-building hormone testosterone are chiefly influenced by the percentages of foods in the diet. Therefore, the percentages of protein, carbohydrates and fat can have dramatic effects on changes in body composition. For instance, if you want to add muscle rapidly, a low protein-to-carbohydrate ratio and a moderately high fat intake are necessary for maximal testosterone output.^{10,11} That's not to suggest that you should reduce protein intake but, rather, that the percentage of carbs in the diet should be somewhat greater than the protein.¹⁰ Furthermore, the source of food also influences testosterone concentration; for example, a vegetarian diet produces much lower testosterone levels than a meat-rich diet.¹²

A diet high in red meat, however, also contains an abundance of saturated fats. Though the reasons for avoiding saturated fats are well established, such as their contribution to heart disease, other forms of fat can be quite beneficial for normal metabolism and hormone production. For example, the fat in fish is valuable. In addition, olive, sunflower and canola oils are rich in monounsaturated fatty acids, a form of fat that's a powerful stimulant of testosterone.¹⁰



The Importance of Nutrient Timing

The number and content of daily meals is an extremely important but overlooked facet of proper nutrition. The timing and quality of foods you eat, especially pre- and post-workout, often means the difference between a successful diet and another failed attempt at physique enhancement. Skipping breakfast, avoiding postworkout meals and consuming high-glycemic carbohydrate

before workouts can easily transform a sound meal plan into a disaster. In addition, even the most sensible diets ignore the crucial nature of nutrient timing.

Elevating the metabolic rate is one of the most efficient ways to burn fat. The process of digestion of meals requires calories by itself, so the more often your body must break down food, the more efficient it becomes. Therefore, you should eat small meals throughout the day to maximize your metabolic response—and breakfast is the most important meal of the day, although the postworkout meal may be equally important. Studies have shown that diets that include a large breakfast result in significantly greater fat loss than diets that avoid it. Since the metabolic rate is fastest in the morning and slows throughout the day, it's more likely that the calories you eat at breakfast will be used by the body and not stored as fat. Skipping breakfast, on the other hand, may result in vital losses of muscle and a subsequent decrease in metabolism.

The postworkout meal is equally essential for much the same reason. Your body exhibits an elevated metabolic rate after you exercise, much as it does when you awaken. Not eating food after you exercise, therefore, results in muscle tissue breakdown and, of course, a corresponding tumble of the metabolic rate. Research has proven that the rate of protein synthesis doubles following exercise and remains elevated for

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more than 24 hours.^{13,14} In other words, the body is primed for the acceptance of protein for muscle maintenance and growth. Equally important is the need for consuming plenty of carbohydrates. After you work out, your body is somewhat depleted of its glycogen stores. Remarkably, studies have shown that high-glycemic carbohydrates are the preferred source for replenishing the body's energy stores after training.¹⁵ Not only does that result in greater storage for recovery and subsequent workouts, but it also significantly decreases muscle breakdown.¹⁶

Postworkout meals should contain about twice the normal amount of carbohydrates and protein, and you should eat them immediately following exercise. For example, if you were eating five meals per day and 3,000 calories, your postworkout meal would be approximately 1,000 calories, while the other four meals would average 500. Postworkout meals should also contain a larger percentage of protein than preworkout meals to keep up with the body's elevated protein synthesis rate.

People make a lot of mistakes with the preworkout meal. How many fitness enthusiasts eat a bagel before exercise? Due to their alleged energy benefits, bagels are a popular preworkout food, but if you look at their glycemic index, it's a whopping 103. The detrimental effects of eating such high-glycemic carbs before training are monumental. The corresponding insulin response will not only decrease energy stores for exercise, but it will also prevent fat breakdown. Fortunately, low-glycemic foods have much the opposite effect. They improve exercise performance without significantly compromising energy stores after a workout.^{9,17} That, in turn, leads to enhanced recovery and accelerated progress.

Consistency

A suggested meal plan [such as the one at the back of this book] isn't perfect. You'll need to tinker in order to determine the ideal diet for you. Building a physique takes time, dedication and consistency, and losing or gaining weight should be a gradual process to ensure the right kind of changes. Don't rush it, stay focused and consistent, and you'll move ever closer to physical excellence.

Editor's note: Jeffery Stout, Ph.D., received his doctorate in exercise physiology from the University of Nebraska-Lincoln and is certified by the National Strength and Conditioning Association. He specializes in neuromuscular fatigue, body composition and ergogenic aids and has published more than 70 manuscripts, abstracts and national presentations in nationally and internationally recognized journals. He's currently an assistant professor and the director of the Human Performance Research Laboratory at Creighton University in Omaha, Nebraska. In addition, he serves on the editorial board for *Medicine and Science in Sports and Exercise* and the *Journal of Strength and Conditioning Research*.

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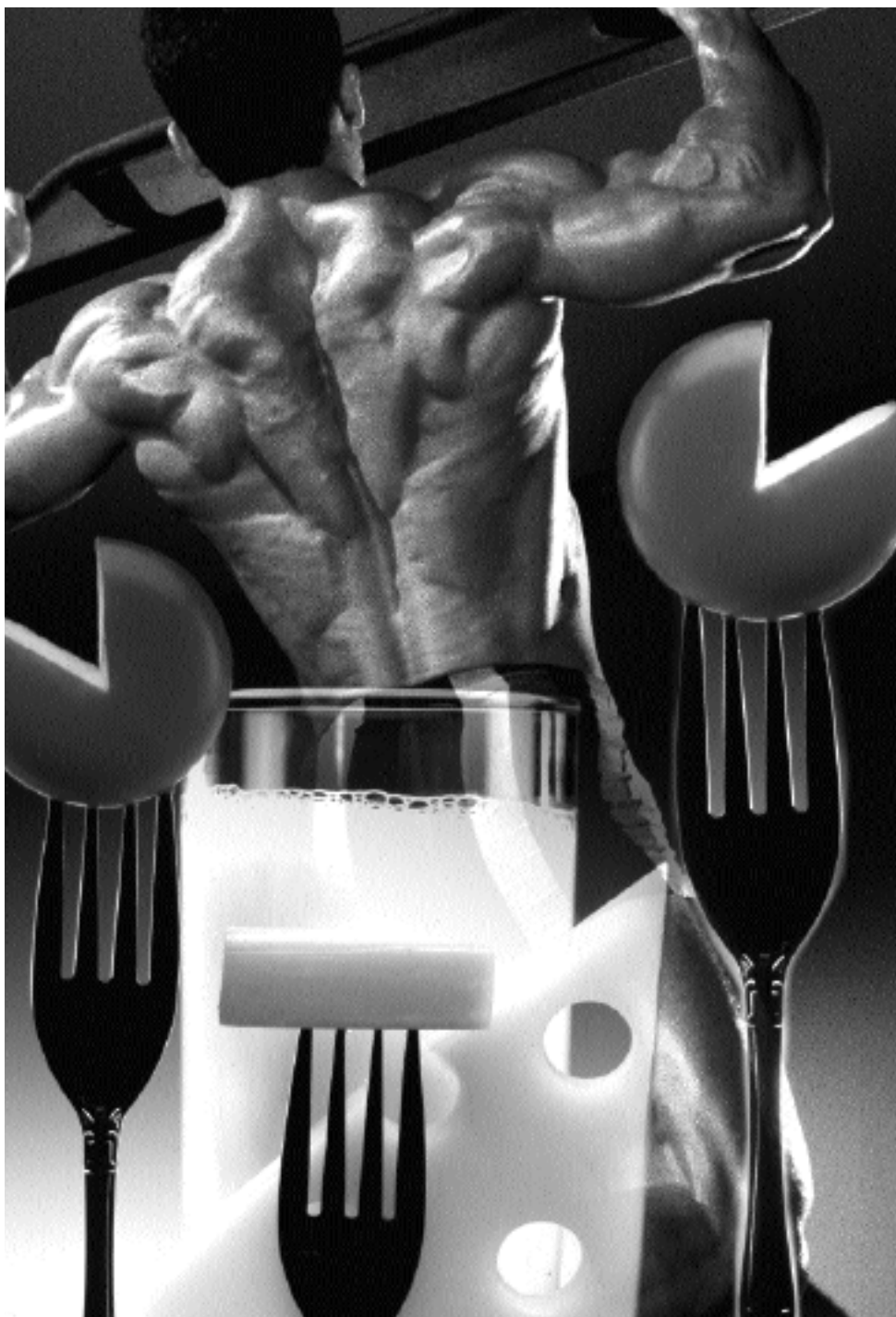
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***Protein: Muscle
Building Blocks***

2



Protein and Bodybuilding

by Daniel Curtis, R.D.

At a sports nutrition seminar I attended some time back, a woman who was a marathon competitor and the author of several books on sports nutrition gave a lecture on optimal nutrition for various sports, including carb loading, adequate hydration and carb snacks to eat during endurance events. She presented her material well and supported it with well-designed studies.

Suddenly, in the middle of her presentation, however, she flashed a slide of former Mr. Olympia Chris Dickerson. The photo was great, but her subsequent comments regarding bodybuilding nutrition were not. Her take on it was this: "When a young man comes in to see me regarding nutrition and bodybuilding, I simply emphasize that all he needs are well-balanced meals. Using protein powders and all those other supplements is a waste of time and money and won't add beneficial results. If he's adamant that he must have something in addition to balanced meals, I tell him to buy dry nonfat milk and add it to his beverages. I do this to pacify him, as it isn't necessary. The literature shows that bodybuilders really don't need any more protein than the RDA [recommended dietary allowance] of 0.8 to 1.0 grams per kilogram of bodyweight per day."

Hogwash!

For a 154-pound man, that's 70 grams of protein per day. Obviously, the woman knew less about bodybuilding and nutrition than most bodybuilders know about marathons.

The sad part was, the auditorium was packed with dietitians, physical therapists, sports trainers and other health professionals, who took her words as gospel.

Is that really what "the literature shows"? Let's review it and see.

My favorite study, although not recent, was reported in the highly respected *American Journal of Clinical Nutrition* (28:29-35; 1975). It involved men performing "heavy physical activity," including isometric exercises, treadmill sessions, stationary bike riding and other "sports activities," during

a 40-day period.

One group took in 100 grams of protein per day; the other, 197 grams. The calories were the same for both groups.

What were the results? The researchers reported that the additional protein "did not enhance physical performance." That means the men who ate the higher-protein diet didn't walk longer on the treadmill, ride further on the bike or apply more pressure on the isometric exercises. The study concluded that consuming additional protein failed to improve sports performance and so was "unnecessary." Nevertheless, it did have an interesting "side effect." The researchers went on to report that the men who ate the high-protein diet did "increase body protein stores and muscle mass."

Oops! I guess the sports nutrition author forgot to mention that while extra protein won't help those young men she counsels lift heavier weights or enable them to train longer, it will let them build bigger muscles. (Of course, the irony is, that's why they come to her in the first place—they want bigger muscles.)

That's what success means to bodybuilders—more muscle mass. The guy with 20-inch arms couldn't care less about the guy who can curl 20 more pounds than he can but has arms that are only 17 inches. That's the reason bodybuilders never win the World's Strongest Man Competition, though they often place higher than most other sports superstars. The winners are usually the guys with big muscles and big bellies—in other words, the strength athletes.

If your goal is simply to be stronger, then use low repetitions and heavy weights and eat like a horse, without worrying about muscle size and symmetry. If your primary goal is bigger muscles without excess fat (you'll also increase your strength to a significant degree), then the literature clearly states that you do need to increase protein intake. In the study cited above, the group that gained more muscle mass ate twice as much protein as the control group. They didn't do it just by eating more food. In order to reach the high protein

A positive nitrogen balance indicates that the body is taking in more protein (nitrogen) than it excretes. You must have a positive nitrogen balance before muscle growth can begin, as your body builds the new muscle with the extra.

intake without unnecessary fat and sugar, they used Casein (a milk protein isolate—not powdered milk) and Meritene, an early protein supplement that was often used in hospitals.

A more recent study that was reported in the *International Journal of Sports Nutrition* (1:127-145; 1991) came to a very different conclusion than the 1975 study: “Present data indicate that strength athletes should consume 1.5 to 2.0 grams of protein per kilogram of bodyweight per day, which is 188 to 250 percent of the RDA for protein.”

The idea that bodybuilders need more protein is backed up by numerous other studies.

•As reported in the *Journal of Sports Medicine* (8[3]:161; 1989), “Weightlifting training can also lead to a daily protein requirement that exceeds the current RDA.”

•In the journal *Metabolism* (12:259-274; 1970) the authors of another study found that 2.0 to 2.2 grams of protein per kilogram of bodyweight per day was “barely sufficient to maintain nitrogen balance during moderate-intensity strength training.” Their conclusion was that a weightlifter’s protein requirement “increased proportionally to training intensity.”

•An article titled “Maximizing Performance With Nutrition,” published in *Medicine and Science in Sports and Exercise* (19, July ’97), reported that “the protein RDA may be 10 to 100 percent higher for individuals who exercise on a regular basis. Optimal intakes, although unknown, may be even higher, especially for individuals attempting to increase muscle mass and strength.” In reviewing a number of studies, the author stated that “these studies indicate that the current protein RDA is insufficient for both strength and endurance athletes, and several suggest that the actual requirement is considerably higher.”

A positive nitrogen balance indicates that the body is taking in more protein (nitrogen) than it excretes. You must have a positive nitrogen balance before muscle growth can begin, as your body builds the new muscle with the extra. There’s some speculation that as positive nitrogen balance increases, so do muscle size and strength. The last article suggested that “perhaps, by maintaining a more positive nitrogen balance, protein synthesis would be further enhanced, leading to larger and stronger muscles.” It pointed to a study that involved elite Romanian weightlifters who increased muscle mass by 6 percent and strength by 5 percent when their protein intake was increased from 225 percent of the RDA to 438 percent.

Why have the study results differed so much about the amount of protein necessary for muscle growth? According to the authors of that last article, “Exercise intensity appears critical and may explain why some studies have not observed an increased protein requirement.”

As for the frequently mentioned health hazards—including the claim that excess protein can cause liver or kidney damage: “Actually, except in preexisting liver or kidney abnormalities, there is little documented evidence of health problems due to a high protein intake.... In an active

individual the fate of ingested protein is likely quite different than in a sedentary individual.”

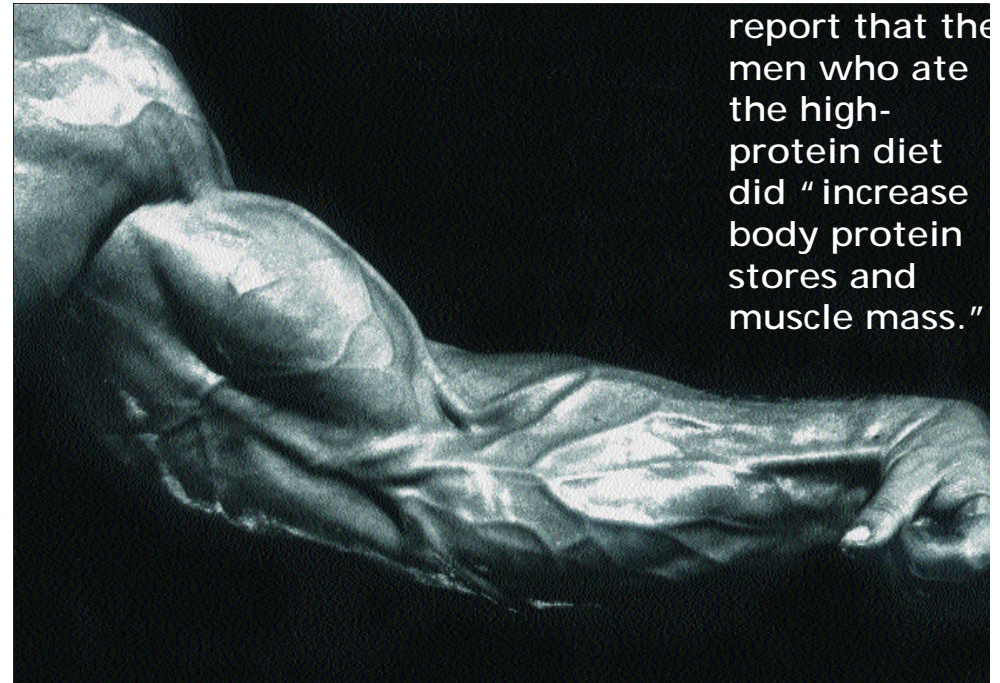
So the scientific literature doesn’t clearly state that bodybuilders don’t need additional protein to build muscle mass. In fact, it clearly states the opposite—that bodybuilders looking to increase muscle size need significantly more protein than nonbodybuilders.

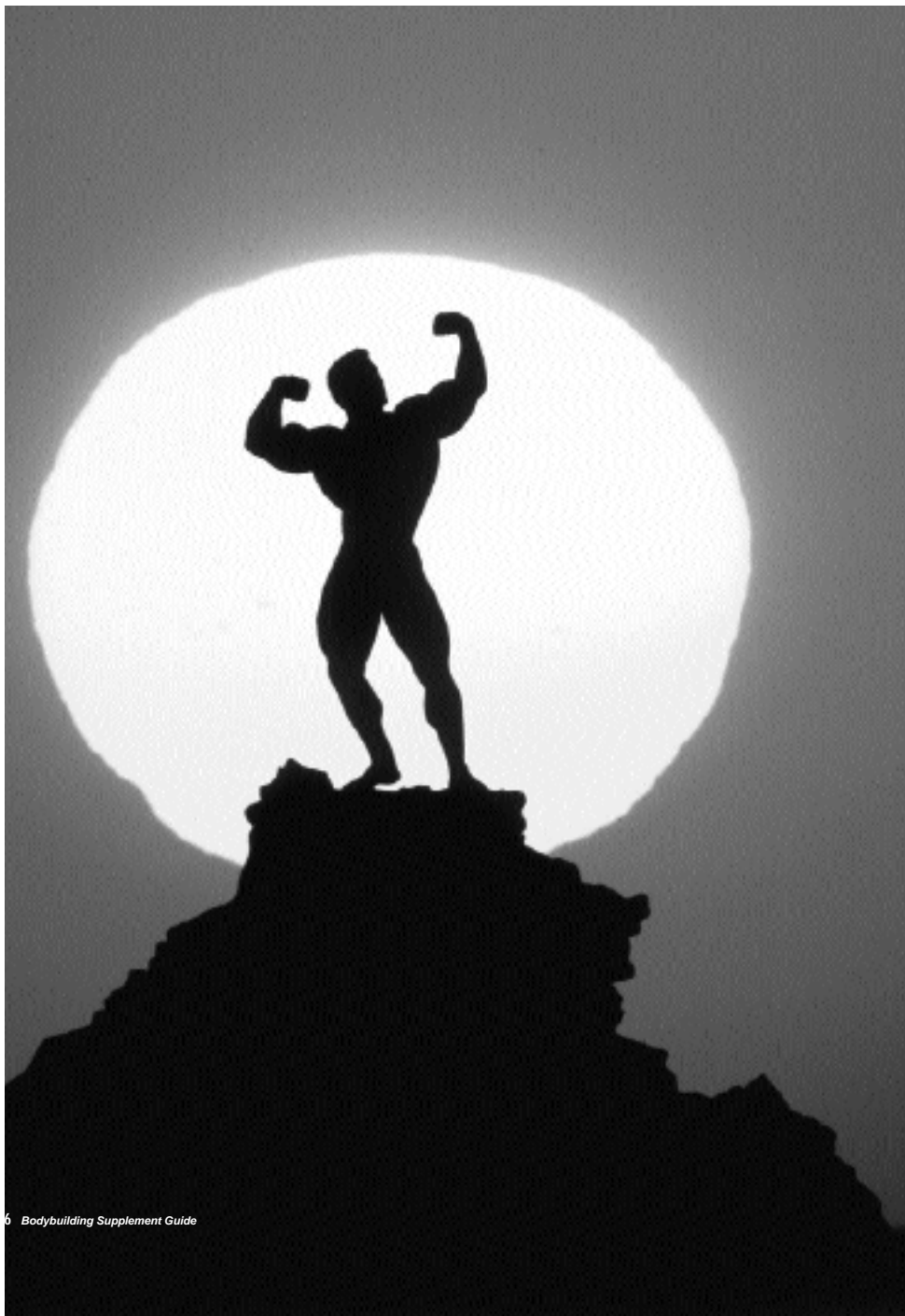
To tell people to simply eat more at meals is very ambiguous. They may eat more fats and carbohydrates, in which case their muscles won’t grow but their waists certainly will. Remember that in the first study cited above, both groups of subjects ate the same calories but one got double the protein with that calorie level, and they were the ones who gained mass.

The bottom line is that bodybuilders need more protein, and supplements like protein powders do help. You also want to be leery of so-called nutrition experts who aren’t familiar with bodybuilding and think that performance in bodybuilding equates to performance in other sports. In bodybuilding, performance means big, symmetrical muscles—and for that very reason bodybuilding nutrition is a different animal from nutrition for other sports.

The researchers reported that the additional protein “did not enhance physical performance.” Nevertheless, it did have an interesting “side effect.”

The researchers went on to report that the men who ate the high-protein diet did “increase body protein stores and muscle mass.”





Wheys and Means

Interview by Jerry Brainum

When it comes to protein intake, bodybuilders tend to be quite savvy. Many can tell you precisely how many grams of protein are in an egg or a chicken breast.

They take the meaning of the word protein literally, with the perception that it's the most important nutrient for successful muscle building. Few bodybuilders would argue about the necessity of consuming increased amounts of protein to foster anabolic effects in muscle. Points of both contention and confusion arise, however, when it comes to the subject of protein supplements.

The fact that so many different kinds of high-tech protein supplements are now available doesn't clarify the issue. The ads all sound scientific, a fact that's underscored by the inclusion of medical references and sometimes even quotes from medical professionals, who appear to endorse the product's efficacy. The many scientific-sounding terms that are bandied about in the ads, such as ionization, cross-flow filtration and other equally nebulous words, further obfuscate an already confusing subject.

To help clear up the confusion, much of which is the result of misrepresentation and factually false advertising, I contacted an expert on the subject. He's worked in protein research and development for more than 25 years, and he's involved with many companies that sell protein supplements or meal-replacement formulas. Since he prefers to maintain good relations with all of them, he's requested that I keep his identity confidential.

By the way, this guy is real; he's not a fictional character or a composite of several people rolled into one, something that's been done in several other publications. The man was motivated to give this interview by the many misrepresentations and outright lies he sees in protein ads. As such, he's providing a public service for consumers to make informed decisions based on fact rather than hearsay.

Q: *Some nutrition texts list the biological value*

(BV) of whey as 104, yet many advertisements for whey protein supplements boast of biological values as high as 159. Why the apparent discrepancy?

A: Biological value is an attempt to measure how efficiently protein is used in the body. To determine a food's BV, scientists provide a measured intake of protein, then note the nitrogen uptake vs. nitrogen excretion. That's a gross simplification, since the actual process is more complex.

In theory, a biological value of 100 is maximal. The BV for whey is often listed at 104 because the extra 4 percent represents a margin of error in the calculation. Even so, biological value is not a universally accepted measure of protein quality because of several factors. For example, BV testing is always done in the fasting state, which affects nitrogen uptake differently from what takes place when subjects are in a fed state. Simply put, not eating changes the way the body absorbs nitrogen in protein.

The 159 BV value for whey you see in some advertisements comes from a study in which the author quoted two earlier researchers who had claimed a 159 BV for whey protein. The problem is, the researchers had confused BV with chemical score, which involves measuring the activity of amino acids in the body. The 159 figure refers to whey's chemical score, not its biological value. A true biological value of 159 for a protein just isn't possible, since the maximum BV is around the 100 mark.

Q: *A number of high-tech terms are frequently mentioned in ads for commercial whey products, such as ionization and cross-flow filtration. What do they mean, and are some processing techniques better than others?*

A: To understand the answer to that question, you need to know the history of whey proteins. Until about 25 years ago whey was considered a waste product of the dairy industry. You made cheese or casein from milk, and the by-product of the manufacturing process was whey. The question

The biologically active whey protein fractions, such as lactoferrin, are just about nonexistent in true ion-exchange whey protein isolate. It's a notable disadvantage because the limited whey fractions have considerable health benefits.

facing dairy companies was, What do we do with all that whey?

In its raw state whey is about 6 percent solids, is an unappetizing greenish color and both looks and tastes terrible. It spoils easily due to its high content of lactose (milk sugar), which is a favorite food of bacteria. For the most part whey didn't appear to hold much commercial promise for dairy factories. As a result, they simply dumped their whey in nearby rivers and streams, which quickly led to an environmental hazard due to the high biological oxidation demand of whey solids, something the government frowned on.

The dairy factories began processing whey into a powder containing 11 percent protein, 72 percent lactose and some ash, or minerals. It was yellow, and it didn't taste great. Some factories persisted in dumping whey, such as one in Australia that built a pipeline to dump it directly into the ocean.

Eventually, a membrane system was developed to filter whey. The first process was called ultrafiltration, and it was developed by the French. It involved separating the whey protein from the ash and lactose, which resulted in a 35 to 70 percent protein content. The process continued to be refined, particularly for the Japanese market, where there's a high tax on the import of any protein that has less than an 80 percent protein content. The Japanese were huge consumers of whey because they used it as a substitute for egg white in certain foods.

The next big breakthrough in whey processing occurred about 15 years ago, when a Welsh engineer developed the ion-exchange process. This process revolved around the positive and negative charges, or ion properties, of whey proteins. It featured the use of a resin to isolate the protein material from the whey, adjusting the pH, or acidity level, along the way. This was followed by ultrafiltration methods to further concentrate the protein. He called his product Bipro whey protein isolate. It provided an unprecedented 90 percent protein content while containing less than 1 percent lactose.

The inventor of this ion-exchange process patented its use in all types of applications. Upon later learning that he had terminal cancer, however, the Welshman put his whey patents up for sale. They were purchased by a company that owned a dairy business in Minnesota. That company evolved to Davisco, which today manufactures Bipro. The important point is that this product is a true whey protein isolate, which means that it contains more than 90 percent protein.

Since Davisco now had a lock on the resin method of manufacturing a whey protein isolate, competing dairy companies sought another way to produce higher-protein whey powders that wouldn't infringe on patents held by Davisco. Enter microfiltration, which featured filtering membranes with microscopic holes. Still another process that used even smaller holes in the filtering membranes for whey was called nanofiltration. The smaller the holes in the filtering membranes, the more expensive the process.

The usual whey processing used today involves an initial ultrafiltra-

tion, which brings the protein content to 75 to 80 percent. The resulting whey liquid is run through either micro- or nanofiltration, screening out more fat and lactose. That results in the whey's having about 1 percent fat content, while the protein content goes up to 81 to 86.5 percent.

Cross-flow filtration is more of an advertising ploy used by a particular company than the new technical advance the ads imply. In reality, this type of whey processing is no better than the others.

Q: What are the drawbacks and advantages of the various whey-processing techniques?

A: True ion-exchange whey is clear in solution, an advantage if you're using it in bottled protein drinks. This is the Bipro whey, since Bipro's maker, Davisco, still retains the patents for producing ion-exchange whey. Among the disadvantages of ion-exchange whey are the high price and limited supply.

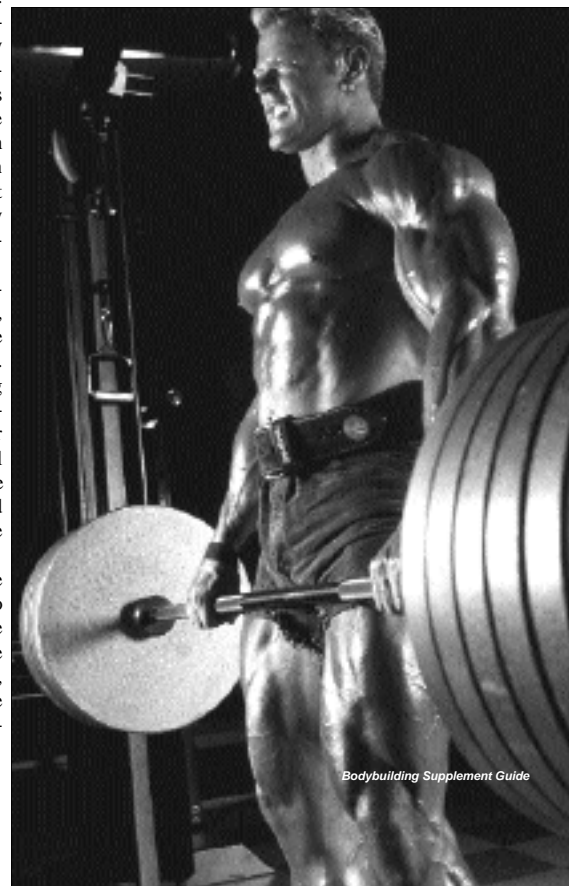
In addition, studies show that ion-exchange whey protein isolates sometimes contain as much as 70 percent beta-lactoglobulin and as little as 10 percent alpha-lactalbumin.

Those percentages aren't even similar to the ones that are naturally found in cow's milk and are significantly different from the proportions found in mother's milk, where alpha-lactalbumin content is high and there's no beta-lactoglobulin present. The significance is that beta-lactoglobulin is considerably more allergenic than alpha-lactalbumin in humans.

The biologically active whey protein fractions, such as lactoferrin, are just about nonexistent in true ion-exchange whey protein isolate. This has to do with the processing system used to produce ion-exchange whey, which doesn't favor the retention of the smaller vital whey protein fractions. It's a notable disadvantage because the limited whey fractions have considerable health benefits.

The primary disadvantage of the filtered whey proteins as opposed to the ion-exchange variety is that the filtered types aren't as pure. True ion-exchange protein—specifically, Bipro—is 90 percent protein, while filtered whey protein isolates aver-

Cross-flow filtration is more of an advertising ploy than the new technical advance the ads imply.



Human mother's milk contains a balance of 50 to 60 percent whey protein-to-40 to 50 percent casein protein. That's a far different balance from what you find in cow's milk, which is about 80 percent casein and 20 percent whey protein.

age 86.5 percent protein on an as-is basis. The filtered whey also contains slightly higher fat and lactose contents, although the differences aren't significant enough to matter to a consumer.

The advantages of filtered whey proteins include higher levels of valuable whey protein fractions, such as proteose peptone and lactoferrin, and the much heralded glycomacropptides.

Lactalbumin is often used as a synonym for whey protein, which isn't quite correct. In the protein industry the word lactalbumin refers to a protein powder manufactured from whey using a high heat process. Lactalbumin contains abnormally high amounts of heat-denatured beta-lactoglobulin. Since high heat and acid are used in the manufacture of lactalbumin, most of the vital whey protein fractions present in the powder become denatured, or broken apart.

The original ion-exchange proteins offered to bodybuilders about five years ago were probably the lowest quality from a nutritional standpoint when compared to ultrafiltered whey. One frequent criticism of ultrafiltered whey is that it has a higher fat content. But the truth is that all whey proteins contain some fat, since completely removing all traces of fat would require hydrolyzing the protein, which in turn denatures the protein. Once protein is denatured, its biological activity is gone.

The fat bound in the whey protein structure is higher in saturated fat and cholesterol than normal milk fat. The reason you don't often see the true fat content of whey supplements listed is that the bound fat in the whey can only be analyzed by acid hydrolysis, which would denature the native proteins in the whey. The fat content of whey is usually analyzed by ether extraction, which only measures free fat, not the fat bound to proteins. Using the ether extraction technique results in a much lower—though inaccurate—listing of the fat content of a whey protein supplement.

In fact, I've yet to see a commercial whey protein supplement that has a true listing of its fat and cholesterol content on the label. If these companies get caught by the Food and Drug Administration, they'll face stiff penalties for false labeling. Any milk-derived protein supplement or meal replacement that lists zero fat and cholesterol on the label is misleading consumers and may be guilty of fraudulent label practices.

For every 50 grams of milk-derived protein per serving, the cholesterol content will probably equal 50 to 75 milligrams. In 20 grams of whey protein there will be at least 15 milligrams of cholesterol, and if one of the primary ingredients listed on the label is whey protein concentrate, the cholesterol levels are probably closer to 50 milligrams or higher.

Q: So the hidden fat in all whey protein supplements is a disadvantage?

A: Not unless you consider the various growth factors found in whey proteins a liability, which I don't think most bodybuilders interested in



building muscle would tend to do. Included in the fat globule membrane of whey or milk are various anabolic factors, such as IGF-1. If you were to completely eliminate all the fat in whey, you'd also be throwing out those coveted anabolic factors.

Q: Mother's milk is often called the ideal protein, but are the protein proportions in mother's milk ideal for active, athletic adults?

A: Human mother's milk contains a balance of 50 to 60 percent whey protein-to-40 to

50 percent casein protein. That's a far different balance from what you find in cow's milk, which is about 80 percent casein and 20 percent whey protein. Also, the types of proteins present in the two milks are significantly different. Human mother's milk contains as much as 17 percent lactoferrin, while cow's milk contains about 1 percent lactoferrin. The dominant whey protein fraction in human mother's milk is alpha-lactalbumin, while the dominant whey protein fraction in cow's milk is beta-lactoglobulin. Human mother's milk doesn't contain any beta-lactoglobulin, a highly allergenic protein in humans compared to alpha-lactalbumin.

Nature doesn't do anything by chance, and the high content of lactoferrin found in mother's milk is there for a reason. Among other properties lactoferrin has antiviral activity and is a potent immune system booster. That's clearly advantageous for newborn humans, who lack full immune system function. From an athletic standpoint, lactoferrin may reduce tissue regrowth time. Some studies have shown that it may assist in increasing tissue regrowth.

Lactoferrin is one reason that you can't duplicate mother's milk. The cost of purified lactoferrin is prohibitively expensive. Another factor making it difficult to duplicate mother's milk is the beta-lactoglobulin content of cow's whey protein. Infant formula companies have experienced considerable difficulty in making efficacious products from cow's milk protein. In order to make the formula less allergenic to human infants, they usually hydrolyze the whey protein to a high degree. If the beta-lactoglobulin is sufficiently hydrolyzed, its allergenicity in humans is decreased.

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Generally, whey protein concentrate contains more lactoferrin than isolates. From both growth-promoting and health standpoints whey protein concentrates may be best for bodybuilding purposes.

It may be difficult to exactly duplicate human mother's milk, but one can at least try to achieve the proper whey-to-casein ratio. It's only logical to conclude that if nature makes mother's milk 50 percent whey protein-to-50 percent casein, that ratio is probably best for growing humans. Nature didn't make mother's milk from 100 percent whey protein or 90 percent casein. It seems obvious that growing humans should thrive on the natural balance of whey protein and casein that's found in mother's milk.

Q: What constitutes a good whey protein supplement?

A: Contrary to those ubiquitous ads, the type of whey processing, whether filtration or ion exchange, has little to do with the ultimate quality of the supplement. All changes in pH levels or exposure to high temperatures affect protein quality by promoting denaturation, the permanent breakdown of the natural protein structures. You want to maintain the native structure of the various protein fractions contained in whey as much as possible. You're after biologically active proteins, and you want to avoid denaturing them because it would minimize their biological activity and, therefore, their value to customers.

The manufacturers who supply the raw protein material vary in their processing techniques, so in many factories each batch of protein may differ in quality from the next. Even the way the cows are fed has an effect on protein quality.

All things being equal, the factory supplying the whey determines the quality of the finished product. Some factories use harsher processing techniques that destroy the delicate whey protein fractions. You cannot, however, completely avoid denaturation because of the necessity of killing existing bacteria before filtering the whey. That involves pasteurization, or the use of heat, which unavoidably alters some protein.

As a consumer you want to look for a company that actively does everything it can to preserve the vital whey protein fractions. Some companies don't bother to analyze the batches of whey they receive and often get their whey from various sources.

You also want to look for whey that contains the greatest amounts of those important whey protein fractions. Generally, whey protein concentrate contains more lactoferrin than whey protein isolates. In fact, the concentrates contain double the amount of health-promoting immunoglobulins than isolates have. In addition, the concentrates are less expensive. Thus, from both growth-promoting and health standpoints whey protein concentrates may be best for bodybuilding purposes.

Q: Many people worry about the lactose, or milk sugar, content of whey because of lactose intolerance. Which types of whey are best for them?

A: Whey protein concentrate contains 6 to 7 percent lactose, while whey isolates contain only 1 percent lactose. It sounds significant until you consider that for every 100 grams of whey protein isolate you get 86.5 grams of protein and 1 gram of lactose. For the same quantity of whey protein concentrate you get 80 grams of protein and six to seven

grams of lactose. I don't think that amount would approach the threshold that results in symptoms of lactose intolerance.

What people should be concerned about is maintaining the health of their intestinal membranes, since that's the area most likely affected by dietary changes. One way to do that is to take glutamine. The amino acid fuels the regeneration of the intestinal lining, which breaks down every three days. The body also uses up available glutamine under high-stress conditions, as it's a favored fuel of immune cells. Anyone who's under stress, including the stress of exercise, should aim to take in about 20 to 25 grams of glutamine daily divided into smaller doses of about four to five grams each.

Q: Various commercial whey products tout their glutamine content, often referring to "glutamine peptides." Is it possible to take in enough glutamine by using a whey supplement?

A: While glutamine makes up half the body's amino acid pool, whey protein contains about 6 percent peptide-bonded glutamine. So 100 grams of whey protein provide about six grams of glutamine. On the other hand, casein, the other milk protein, naturally contains 8 to 10 percent glutamine.

The term peptide-bonded glutamine refers to glutamine that is linked to at least one other amino acid via a peptide bond, or peptide chain. The bonded glutamine is superior to L-glutamine, or free glutamine, because the free form of the amino acid is very unstable in the presence of water, heat and pH changes. The half-life of glutamine in water is comparatively short, which is something to think about the next time you see a drink or protein bar that touts its L-glutamine content.

Peptide-bonded glutamine is far more stable than the free-form variety, able to resist such hostile environments as acid and heat. By the way, peptide-bonded amino acids are always better than free-form, since free-form amino acids compete with each other for absorption into the body. In contrast, peptide-linked aminos are absorbed by a more orderly and efficient mechanism. Some studies have shown that peptide-bonded glutamine is absorbed as much as 10 times more efficiently than L-glutamine into the body.

Some companies use deceitful tactics that make it appear that significant amounts of peptide-bonded glutamine have been added to their product, including claims that a product contains 10 grams of peptide-bonded glutamine. The question you want to ask is, How much of that is actual glutamine? It may be less than you think.

Others companies tout a "whey-glutamine-peptide blend." What is that? The glutamine content of whey is so low that a whey-glutamine-peptide blend would be ridiculous, and I'm not even sure the FDA would allow the name to be used. A so-called whey-glutamine-peptide product could never provide the same glutamine content as you get from what's commonly called peptide-bonded glutamine.

If you're looking for the latest nutritional superstar, glycomacropeptides, you want to consume whey protein concentrate made from

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Casein, in its native micelle structure, forms a stable suspension in water and contains a number of biologically active peptide sequences that could be of great value to athletes.

cheese whey, which generally contains far more of that protein fraction than whey protein isolate does. I once had one of the most popular whey protein supplements analyzed for protein fractions and found that it contained almost none of the bioactive protein fractions, including glycomacropeptides.

Q: Is hydrolyzed whey useless because it's denatured?

A: No. When you hydrolyze whey protein, you permanently modify the native protein structure, meaning that the protein is denatured and so has little or no biological activity. The hydrolysis process breaks apart peptide bonds, which destroys the protein structure. Even so, you still get the amino acids of whey proteins from the hydrolyzed whey protein. Half the reason we eat proteins is to get those healthful smaller protein chains.

Q: Does whey protein really help to suppress appetite?

A: The glycomacropeptide fraction of whey protein stimulates the release of cholecystokinin (CCK) in the gut. CCK may blunt food consumption while also triggering pancreatic digestive enzyme release and insulin secretion. An important—and often overlooked—point, however, is that glycomacropeptides are found only in cheese whey. What's more, you have to be careful about saying that whey protein helps to suppress appetite. In fact, the human stomach can make glycomacropeptides from casein when it's consumed in its native structure.

Q: Why does casein have a bad reputation compared to whey?

A: Contrary to what some misinformed people have written, casein isn't a bad protein. It is very stable and resistant to pH or heat denaturation when compared to whey proteins. Many people confuse casein with caseinate, which is made by adjusting the pH of acid casein toward a more neutral level by using an alkali. The resultant caseinate is more soluble in water than acid casein and provides a better mouth feel in food products. Casein, in its native micelle structure, however, forms a stable suspension in water and contains a number of biologically active peptide sequences that could be of great value to athletes. Native micellar casein has a different structure from caseinate and is probably used differently by the body.

Caseinate isn't cheap; it costs more than a whey protein concentrate. From a nutritional standpoint, caseinate has no drawbacks, contrary to what you may read in whey protein ads. Caseinate is considered to be a high-quality protein source. It's just nonsense to suggest that it will cause gas or indigestion any more than whey or other proteins will. In fact, whey proteins are generally thought to be more allergenic in humans than caseinates.

Q: But isn't whey superior to casein for promoting increased protein synthesis in the body?

A: The study quoted in many current whey protein ads compared the metabolic effects of consuming native structure whey proteins and native structure casein in active, fed subjects. It differs from older studies, which often used fasted subjects, who don't realistically reflect

common protein uptake in an athlete's body. The study found that whey protein consumption leads to a rapid but transient increase in plasma amino acids levels and a subsequent stimulation of protein synthesis. It also found, however, that amino acid oxidation was increased and that whey protein had no effect at all on catabolic protein breakdown.

The study tells us that when you consume whey protein, it's so rapidly absorbed that much of it is shunted to the liver, where the amino acids are oxidized for energy purposes instead of for synthesizing muscle tissue. The rapid uptake of whey does favor increased protein synthesis. The question is, however, How much of the whey protein is used to make muscle tissue and how much is shunted to the liver for oxidation? An important and misrepresented conclusion of this study is the author's own statement that whey provides zero anticatabolic effects in the body. Many people have erroneously interpreted that finding to state that consuming larger amounts of whey protein more frequently throughout the day will provide the same anticatabolic effect as casein did in the study. That isn't what the study showed, though. The author specifically stated that whey protein effected no change in protein breakdown in the body.

In contrast, the same study found that casein consumption led to a lower, slower and more prolonged appearance of plasma amino acid levels. The authors even stated that the slower amino acid appearance from casein led to a different metabolic response in the body than that of whey protein. Casein consumption slightly increased protein synthesis, and liver oxidation of casein was moderate compared to whey protein. The important point is that the authors clearly said that casein significantly inhibits catabolic protein breakdown in the body. Even more important, they concluded that casein consumption results in a better net protein balance in the body than you get with whey protein.

Unfortunately, there are people in the protein supplement industry who are perverting the results and conclusions of that study to push their marketing agendas. I've read numerous unscientific and invalid interpretations of the study's findings. Instead of being afraid of the effect of the researchers' conclusions on their company's profitability and what it means to their marketing tactics, these people should be educating the industry about the potential benefits for bodybuilders.

For example, the study confirmed that whey protein is rapidly absorbed and strongly promotes protein synthesis. At the same time it also found that casein provides a time-released effect and can significantly blunt catabolic protein breakdown. Instead of trying to bend those results or misinterpret them to fit their company's marketing plan, supplement manufacturers should accept the study results at face value.

Both whey protein and casein provide beneficial effects. They're absorbed at different rates and elicit different metabolic responses. In reality, they complement each other and should be consumed together for maximum benefit. Recall that mother's milk is roughly 50 percent whey protein and 50 percent casein. Any companies that try to convince you

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Look at mother's milk, which is a combination of fast-acting proteins and more prolonged proteins. Fast- and slower-acting protein combinations are the best for any type of growth.



that consuming only whey protein or only casein is the best approach are just blowing smoke. Contrary to what the ads say, there is no scientific basis for their claims. Sure, they can quote many studies, but a closer examination reveals that the studies have little or no applicability in the real world.

Q: Since some studies show increased muscle protein synthesis after exercise, should bodybuilders focus on whey as a postworkout protein source?

A: Look at mother's milk, which is a combination of fast-acting proteins and more prolonged proteins. That takes care of the necessity for rapid protein synthesis while preventing the excess breakdown of newly formed proteins. Fast- and slower-acting protein combinations are the best for any type of growth.

Q: But isn't whey protein richer in anticatabolic branched-chain amino acids?

A: I've had various milk proteins analyzed by a major laboratory for their amino acid profiles. After months of lab analysis I found that contrary to popular belief, the different milk-derived proteins don't markedly differ in amino acid content. First, the results of the amino acid assays varied by as much as 25 percent for any individual amino acid, with an average variance of plus or minus 12 percent. It's difficult to say that one protein contains significantly more of an amino acid when the actual results fall within the percentage of variance.

A leading manufacturer of whey protein supplements used to print right on its label that its product supplied side branched-chain amino acids at a level of 50 percent of the essential amino acid content of the whey protein. I was interested in that claim, so I compared whey protein, caseinate and a whole-milk protein that contained both whey and casein proteins. I found that the whey protein concentrate supplied an average of 49.5 percent of its essential amino acids as side branched-chain amino acids. The caseinate also showed an average side branched-chain amino content of 49.5 percent. The milk protein averaged 49.3 percent. Those results may explain why the company that sold that leading whey protein supplement removed the ridiculous text from its label.

Q: What about combination protein supplements, such as milk, egg and soy?

A: I don't think that soy protein offers benefits for bodybuilders. For example, unlike casein, it doesn't form a good curd in the stomach, which makes it a fast protein. Also, the amino acid pattern in soy is inferior to that of milk proteins and not as favorable for promoting growth.

Egg albumin is similar to the lactalbumin found in milk. The problem with egg protein is that it's highly allergenic, but if you can tolerate it, it's a good protein.

If you look at this issue in terms of survival, it would be a good idea to combine various proteins, including soy. For promoting maximum muscle growth, however, milk proteins are best. That's reflected in a measure of how efficiently protein stimulates growth, which is called the protein efficiency ratio (PER). The currently accepted PER for soy is 1.7 to 1.8. It started out as 1.2, but the PER testing method was modified over a period of years so that soy protein scored better on the test. The result is that soy protein now has an accepted PER of 1.8. For casein it's 2.5.

Q: How accurate are the labels on most current commercial protein supplements?

A: Not very accurate. Most labels misstate the powder contents. That would particularly apply to the protein fractions discussed above; take, for instance, glycomacropeptide, which is a hydrolyzed piece of kappa casein. Manufacturers add hydrolyzed whey proteins to their supplements. The hydrolyzed whey protein may contain pieces of whey peptides that are in the same molecular size range as glycomacropeptides and may even show up on analysis as them, yet they aren't glycomacropeptides. Despite that fact, the protein supplement labels state that they contain a certain amount of glycomacropeptides. Such labels are probably misleading because it would be very hard to guarantee a specific glycomacropeptide content from any current protein source. Also, remember that a true ion-exchange whey protein isolate contains no glycomacropeptides.

Q: What is the ingredient found in some products that's called "complete milk protein"?

A: Complete milk protein is a whole milk protein that is separated from the other constituents of cow's milk by a filtration process. Since no pH changes or excessive heat are used in the processing, the protein retains more of the biologically active protein fractions that are limiting in other protein sources. The casein and whey are in their native, undenatured structures. This is simply protein the way nature intended.

The best combination probably involves a filtered milk protein with whey protein concentrate, since you get all the bioactive protein fractions plus both rapid and extended protein activity in the body. The scenario favors increased protein synthesis and a significant anticatabolic effect.

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Critical Protein Facts

- Human mother's milk contains a balance of 50 to 60 percent whey protein-to-40 to 50 percent casein protein.
- Contrary to those ubiquitous ads, the type of whey processing, whether filtration or ion exchange, has little to do with the ultimate quality of the supplement.
- Bonded glutamine is superior to L-glutamine, or free glutamine, because the free form of the amino acid is very unstable in the presence of water, heat and pH changes. Peptide-bonded amino acids are always better than free-form, since free-form amino acids compete with each other for absorption into the body.
- Caseinate is a high-quality protein source. It's just nonsense to suggest that it will cause gas or indigestion any more than whey or other proteins will. In fact, whey proteins are generally thought to be more allergenic in humans than caseinates.
- The study tells us that when you consume whey protein, it's so rapidly absorbed that much of it is shunted to the liver, where the amino acids are oxidized for energy purposes instead of for synthesizing muscle tissue.
- The same study found that casein consumption led to a lower, slower and more prolonged appearance of plasma amino acid levels. The authors even stated that the slower amino acid appearance from casein led to a different metabolic response in the body than that of whey protein.
- The important point is that the authors clearly said that casein significantly inhibits catabolic protein breakdown in the body. Even more important, they concluded that casein consumption results in a better net protein balance in the body than you get with whey protein.
- Both whey protein and casein provide beneficial effects. They're absorbed at different rates and elicit different metabolic responses. In reality, they complement each other and should be consumed together for maximum benefit.
- Any companies that try to convince you that consuming only whey protein or only casein is the best approach are just blowing smoke. Contrary to what the ads say, there is no scientific basis for their claims. Sure, they can quote many studies, but a closer examination reveals that the studies have little or no applicability in the real world.

A Solution for Smallness

by Michael J.B. McCormick

Much of what follows is in line with advice I was lucky enough to receive in the early 1970s from one of bodybuilding's pioneers, Pete Grymkowski, the co-owner of Gold's Gym International. In order to grow, he said, you have to consume large quantities of the highest-possible-quality protein supplements. In 1973 Pete achieved a peak contest weight of 256 pounds at 5'10", which was in large part due to the consistent consumption of a minimum of 500 grams of protein. That was during a time in which everyone he competed against was getting maybe 200 grams. This article describes a 12-month period in a gifted bodybuilder's career, during which he gained more muscle than he had in the previous eight years. I'll call him Joe, although it's not his real name. What Joe accomplished during that relatively brief 52 weeks can be repeated by anyone willing to let go of old habits and opinions in favor of a more effective approach, particularly with regard to nutrition.

For more than five years Joe had heard NPC national judges tell him, "It's all there. You just need to pack on more beef to take advantage of your structure." He was fed up with missing out on an IFBB pro card year after year. Eventually, he reached a point where he was willing to take any legal steps that would enable him to gain at least 25 pounds.

Following a period of intense introspection, Joe concluded that he'd been training the same way, with the same people, and eating the same food for years. He'd never changed his high-volume, pumping style of training, and he realized that not only was he training too much, but he was also using poor technique. He moved heavy enough weights during those high-volume sessions, but he rarely got sore. What was missing was the so-called feel for the muscle on each rep. He began to understand that he'd been training with excessive momentum.

For more than eight years Joe had trained six days per week, with each session lasting from

1 1/2 to two hours. His total training time in the gym was more than 12 hours each week. He trained individual bodyparts twice per week using 12 to 14 sets per muscle group. In fact, he consistently performed 26 sets per bodypart every week for a total of 156 sets. Joe's training had produced some great results. The best condition he achieved for a national show had been at 227 pounds. He's 6' tall, and for more than seven years he never weighed more than 235 pounds in the off-season. The problem was, he really hadn't made any significant gains for more than five years. His grinding workouts had ceased to be effective. That was the first area that had to be changed.

Joe's shift in training strategy was to significantly reduce the work volume while simultaneously increasing the intensity of each set. It was the first time he'd ever attempted ultra-high-intensity training, and he altered his exercise form radically to emphasize the eccentric—that is, the negative, or lowering—portion of each rep.

Because he was pursuing total momentary muscular failure on every working set, his workouts had to be as short as possible. Joe trained on Monday, Wednesday and Friday for less than 50 minutes per session. His total training time in the gym dropped to less than three hours each week. He trained individual bodyparts once per week at a volume of three to six sets per muscle group, which brought him to a total sets per week of 27, including all bodyparts. That's a volume reduction of 83 percent!

The training modifications were intended to induce a state of temporary muscle damage. Joe trained like a man who was escaping from prison. He poured his soul into the iron.

Damage without repair is death in bodybuilding, so, in order to recuperate from the phenomenal elevation in muscle microtrauma, Joe ate more—a lot more. Previously, his normal daily intake of protein had averaged only 175 grams, all of it coming from whole foods. His dietary modification was to synergize the biochemical recuperation from train-

Joe's incredible 12-month gains—30 pounds of muscle—were in large part the result of his increasing his protein by 250 percent. The lack of sufficient dietary protein is the single biggest obstacle for 90 percent of all bodybuilders.

ing by tripling his protein intake from 175 grams to 525 grams each day.

Granted, Joe was a large athlete, but 500 grams is still one whopping dose of protein. It's pretty difficult to consume that much as whole food. Knowing that, Joe used supplemental milk-and-egg protein throughout the day. He took in five grams of protein per kilo of body-weight each day. He knew that research had documented the fact that taking in 400 percent of the recommended dietary allowance (RDA) for



protein (3.3 grams per kilogram of bodyweight vs. the RDA of 0.8 grams per kilogram) is safe for healthy individuals. More important, he knew that the increased protein load would result in a continuous increase in protein synthesis.

Joe started his transformation on May 12, 1994. His bodyweight was 227.8 pounds, at 15.9 percent bodyfat. One year later, on May 13, 1995, he weighed 258.3 with only 12.8 percent bodyfat. Joe had gained 30.5 pounds of muscle with a concomitant reduction of 3.2 pounds of bodyfat. During that time he performed a total of 156 training sessions, each lasting less than 50 minutes. Joe's complete departure from his prior habits produced more muscle in 365 days than the previous 2,920 days, or eight years, had.

Thirty pounds of muscle is phenomenal for an entire career, let alone a single year. Logical bodybuilders will ask, "But what about the drugs? It had to be the gear he was on that gave him those kinds of gains." The fact is, Joe was controlled and quite modest in his anabolic/androgenic steroid augmentation. There was no change in his program from the beginning to the end of that period. What's more, the amount and type of chemical additives he used were actually less than what he'd used for the previous five years, and still Joe exploded with more than 30 pounds of muscle. So the question is, What did it?

The answer is, Joe earned his new size. It was real and completely legit, and most of it has turned out to be permanent. Joe still weighs 265, and he's clean as a whistle, unable to compete due to a permanent torso injury. Once he hit the 250-pound mark, he never looked back.

The proteins contained in milk-and-egg supplements accomplish the job of growth that whey cannot. They maintain the blood levels of glucose and amino acids long enough to maximize the repair process.

It was the continual supply of amino acids and energy that enabled Joe's bodyweight to climb to 258 pounds in a single year.

Joe's incredible 12-month gains were in large part the result of his increasing his protein by 250 percent. The lack of sufficient dietary protein is the single biggest obstacle for 90 percent of all bodybuilders, and it's a self-imposed one. Most bodybuilders simply don't stay on top of their real protein needs, especially when it counts. The sheer amount of whole food it takes to generate 300-plus grams of protein a day is simply too much for most bodybuilders to eat. Enter a key training aid: milk-and-egg proteins.

The peptides found in milk-and-egg proteins contain numerous growth-activating protein fractions, producing more growth than whey protein. The proteins contained in milk-and-egg supplements accomplish the job of growth that whey cannot. They maintain the blood levels of glucose and amino acids long enough to maximize the repair process. It was the continual supply of amino acids and energy that enabled Joe's bodyweight to climb to 258 pounds in a single year. That's amazing when you consider that recent thinking had milk-and-egg supplements lost in whey protein's dust. Not so. There's a bold new world of size waiting for you. So what are you going to do?

Editor's note: Michael J.B. McCormick is a freelance writer and researcher. His insider knowledge has helped produce the Gold's Gym Encyclopedia of Bodybuilding (NTC/Contemporary Books, 1998) and the soon-to-be-published series Gold's Gym Essentials of Bodybuilding: Building Bulk, Total Torso Training, Book of Big Arms and Total Leg Training. He has been passionately involved in bodybuilding for 25 years.

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Protein Q&A

Q: I just read in [a bodybuilding magazine] that whey is far superior to casein for bodybuilding purposes. Should I be using straight whey protein if I want the fastest gains possible?

A: The author of that article, while singing the praises of whey, missed the point. He states that whey has a higher biological value and is in and out of your system quickly—less than two hours—while casein “clots in your stomach, is released slowly and absorbed over a period of four to six hours.” This trait of casein is a benefit, not the detriment he makes it out to be. It's the exact reason you should use casein in combination with whey—so that your body doesn't slip into a catabolic state between feedings.

Say you have a whey shake at 9 a.m. and then eat lunch at noon. It's good bet that your body won't have any circulating amino acids after 11 a.m. and the starvation mechanism will kick in because whey is in and out so rapidly. That means muscle cannibalization can occur, and unless you enjoy passively tearing down what you fight so hard to build up—like muscle tissue—you should avoid that catabolic state like the plague. Adding casein to the mix ensures that you get both a fast anabolic reaction and a slow anticatabolic absorption.

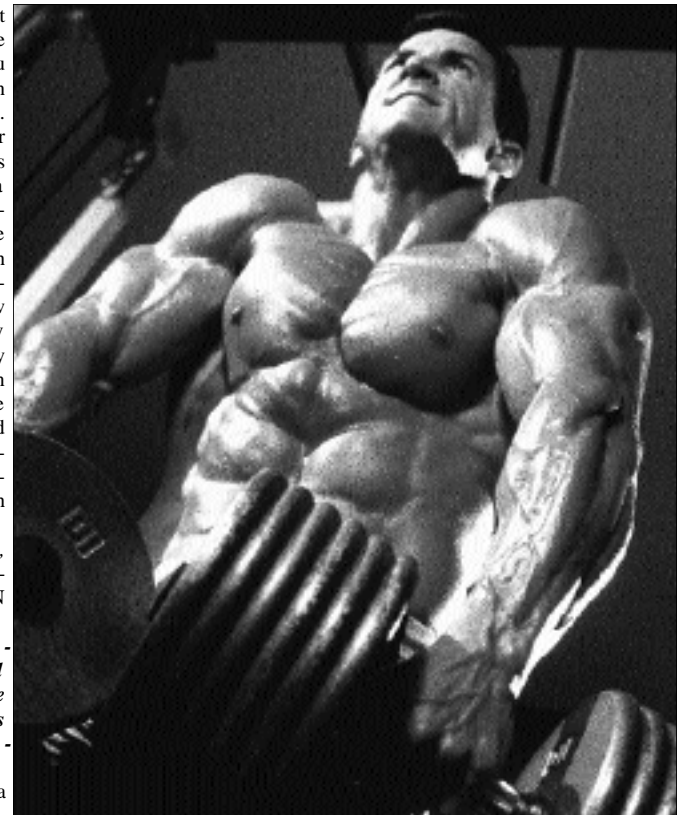
The trickle-feed effect is the reason I believe every protein drink you have should contain both whey and casein.

It doesn't matter whether one protein is better than the other—a highly debatable subject in and of itself. The point is you get much better bodybuilding results with the fast-slow combination, especially if you can't eat every 1 1/2 to two hours on the dot. Take advantage of the latest studies and technology and use protein and meal replacements that include both whey and casein.

—Steve Holman,
editor in chief, IRON-
MAN

Q: Based on your research, experience and observation, what type of diet do you think is best for building muscle and why?

A: I don't believe in a



Sleep time is growth time for only about the first two hours, when growth hormone output is high. After that cortisol levels shoot up and sleep turns into something akin to a catabolic coma.

one-diet-fits-all approach. People have individual food preferences and sensitivities, and that must be considered when you're designing an effective diet. Generally speaking, however, I think that high-protein diets averaging about one to 1 1/2 grams per pound of bodyweight suit the needs of most people seeking added muscle mass. Carbohydrate and fat intakes are more individualized and depend on factors like existing bodyfat levels, activity levels—such as whether you're doing aerobics—and so on.

For most people the popular approach of 40 percent carbs, 30 percent fat and 30 percent protein works well. The fat intake should not contain more than 10 percent saturated fat, with 20 percent being a combination of polyunsaturated fats—say, 10 percent fish oils, or alpha-linoleic, with another 10 percent as linoleic, or omega-6. You need carbs with a high glycemic index after training, with moderate-glycemic-index carbs before training and low-glycemic-index carbs later in the day, assuming decreased activity. [See the end of this book for a balanced diet-and-supplementation template.]

—Jerry Brainum, *bodybuilding and nutrition researcher*

Q: *I've been having trouble sleeping lately, and I know that sleep time is growth time. Do you have any suggestions?*

A: Sleep time is growth time for only about the first two hours, when growth hormone output is high. After that cortisol levels shoot up and sleep turns into something akin to a catabolic coma.

One thing you can do to decrease the catabolic actions of cortisol during the night is to drink a meal replacement right before bed, taking it along with phosphatidylserine. For example, a packet of a meal replacement like Muscle-Link's Muscle Meals has the right balance of calcium and magnesium, a 2-to-1 ratio that improves sleep. Also, the whey-and-casein protein mix will give you both fast and slow amino acid entry to the bloodstream. The casein helps provide a trickle-feed effect so you have amino acids in your system longer, and that can prevent some of the late-night catabolism, as can a PS supplement. Add Cort-Bloc, or one of the other PS supplements that are available, to the mix and you have a potent presleep anabolic-anticatabolic cocktail.

—Steve Holman, *editor in chief, IRONMAN*

***Creatine & Ribose:
Muscle Cell
Energizers and
Volumizers***

3



Creatine Monohydrate— Technically Speaking

by Daniel Gwartney, M.D.

Competitive and recreational athletes use creatine monohydrate for its performance-enhancing, or ergogenic, properties. It's been shown in numerous studies to be beneficial in activities that are dependent on the anaerobic energy system, which includes such sports as powerlifting, sprinting, swimming and field events. Such sports typically involve high-intensity, short-duration movements with short rest breaks during training. The energy for them comes primarily from stored skeletal muscle ATP and ATP regenerated from phosphocreatine stores. Anaerobic glycolysis is another potential energy source, though its relatively slow rate of ATP production prevents it from contributing to short-duration activities; that is, those of less than 30 seconds.

Studies show that oral creatine supplementation increases total muscle creatine stores. Increases in creatine and phosphocreatine have been demonstrated by muscle biopsy, and those results correlate well with studies that measure anaerobic work performance.

To date, there have been no serious adverse effects associated with creatine supplementation; however, an undetermined percentage of creatine users has reported stomach upset, diarrhea and cramping, which suggests poor intestinal absorption. Anecdotal reports of muscle and tendon injuries appear to be related to inappropriate training and supervision during the initial period of creatine supplementation. Athletes may be susceptible to overtraining, or they may develop or exacerbate an imbalance between muscle groups during periods of accelerated strength and performance improvements.

Creatine monohydrate is typically found in powder form, and manufacturer directions recommend consuming it in eight to 16 ounces of water, juice or isotonic sports drink. They also recommend a loading phase at the beginning of a creatine cycle that consists of four to six five-gram servings a day for

four to six days. A maintenance phase then follows, with the recommended dose being five to 20 grams a day. There are some deviations from the recommendations, but there's little evidence to support alternative modes of creatine use.

The majority of problems associated with creatine monohydrate occur during the loading phase. People complain of poor intestinal tolerance, as evidenced by cramps or diarrhea. Commonly, increased fluid consumption resolves the complaints, which are rarely mentioned during the maintenance phase.

There are numerous creatine monohydrate products around. One that has been shown to be beneficial is the combination of creatine and high-glycemic carbohydrates. Studies have shown that creatine uptake into muscle is enhanced in the presence of insulin with those products, which leads to increased muscle creatine stores over what subjects got with straight-creatine supplementation. There are other formula additions to creatine, but none have been shown to be of much benefit. One possible exception is inorganic phosphate salts, which may aid in maintaining the creatine-to-phosphocreatine ratio in the muscle cell.

The addition of carbohydrates has improved the ergogenic value of creatine; however, there's still a barrier keeping people from realizing the complete ergogenic value of creatine. That barrier is poor intestinal absorption. Creatine uptake is mediated by an active sodium dependent transporter, and there's extremely little passive absorption of creatine in the intestine due to the substance's poor solubility in water and the ionic nature in the intestinal environment. Compounding the problem is the supposed downregulation of the creatine transporter that occurs during supplementation. The absorption problem has been clearly demonstrated even during the relatively short loading period. That's consistent with the findings regarding other guanido compounds, such as taurine, in which the intestinal receptor is shown to downreg-

Creatine is of maximum benefit at select times of the day; in the morning after the nighttime fast, for instance, or right after training. These windows of opportunity are short.



0 Bodybuilding Supplement Guide

ulate following oral supplementation.

Overcoming that barrier should effect a significant improvement in creatine's ergogenic profile, both in the acute loading phase and the maintenance phase. Before the introduction of effervescent delivery, that just wasn't possible. The only recourse was to bypass the oral route in favor of intravenous administration. While there may be a place for that in therapeutic environments—for example, where there are patients with certain mitochondrial conditions—it's an unacceptable option for athletic enhancement or recreational use.

Effervescence occurs when weak acids and bases are combined to create a buffered solution at a stable pH. It typically involves the use of bicarbonate salts, which form carbon dioxide gas upon activation. The appearance of the carbon dioxide gas gives the bubbling, or fizzing, effect that you get with popular over-the-counter indigestion and allergy remedies.

Effervescence is a useful and applicable delivery device for creatine for many reasons. First, and possibly most important, is the buffering effect. Stabilizing the pH of the creatine-containing solution at the pI, or isoelectric point, promotes an electrically balanced, or neutral, creatine molecule known as a zwitterion. The net electrical charge of the zwitterion is zero. As creatine is a small molecule, it's now theoretically available for passive absorption—in addition to the active transport that has been shown to downregulate. That's important for two reasons. It provides an alternate and less restricted means of accessing the mesenteric venous system—the transport system can be quickly saturated even during the initial dose. Second, it allows for the continued absorption even during the maintenance phase.

An additional benefit of the buffering effect is the so-called dumping effect. Creatine is of maximum benefit at select times of the day; in the morning after the nighttime fast, for instance, or right after training. These windows of opportunity are short. Studies suggest that a 200-milliliter volume is held in the stomach for 40 minutes to one hour. If you drink more or a meal high in fat or protein is present, that period may extend for hours. The problem is, very little absorption takes place in the stomach by design.

The stomach's role is mostly to grind up and break down the food by acid digestion. Its mucosal lining is nearly impermeable, which protects it from the

destructive effect of the stomach acids.

The duodenum and the remainder of the small intestine are the sites of greatest absorption. The effervescent delivery of creatine causes a pH shift in the stomach, which the body senses as a signal to dump the stomach contents into the duodenum. Once the creatine passes into the duodenum, the greater surface area and absorptive function of the intestinal lining quickly absorb the creatine zwitterions. What's more, the creatine transporters are located in the jejunum and ileum, two other sections of the small intestine.

As the effervescently delivered creatine is almost completely absorbed, you don't have the stomach problems inherent in creatine use. Noneffervescently delivered creatine, particularly after transporter downregulation, is typically passed down the small intestine, drawing water into the lumen of the bowel in an attempt to dilute and dissolve the crystals. The creatine crystals act as an irritant and have a high osmotic pull. Unfortunately, the majority of water transfer takes place in the large intestine, which has very little absorptive capacity. That leaves the creatine in the colon, along with the attendant water load, and it's the water efflux and the presence of the colonic creatine that lead to diarrhea, cramps and dehydration. The greater absorption with effervescent delivery should remove that curse.

Bear in mind that creatine is designed to augment anaerobic work performance. That means a working muscle to near maximal exertion is highly dependent on the amount of available ATP during the period of exertion. Long-distance races and low-intensity-load exercise aren't significantly affected by creatine supplementation. Therefore, in terms of research it's more appropriate to measure the supplement's effects on repetitive sprints, isotonic, isometric or timed recovery resistance training than on marathon running or long-distance cycling.

One study that's been done in the exercise science laboratory is the measure of anaerobic work performed on a cycle ergometer. That measures maximal energy output, which is dependent on ATP and the phosphocreatine shuttle. The study showed an increase in anaerobic work performance (AWP) of 10 percent following a creatine loading phase. Adding carbohydrates increased the AWP to 20 percent over the control group. That was the standard by which creatine products were gauged for the past three years—that is, until effervescent creatine with carbohydrate showed a significant improvement in AWP to 30 percent over the control subjects.

Marketing groups present the findings—and the figures—in confusing terms. Here are the basic facts shown by the research:

- Creatine provides a positive ergogenic effect when used and measured correctly.
- The addition of a high-glycemic carbohydrate enhances the muscle uptake of creatine.
- Thyroid hormone and vitamin E also seem to play a role in mus-

Effervescently delivered creatine with carbohydrate causes a 30 percent increase over the anaerobic work performance (AWP) of control subjects; that is, it's three times, or 300 percent, as effective and 150 percent as effective as creatine and carbohydrate.

Effervescent creatine represents a novel and effective use of a pharmaceutical delivery system that enhances the positive benefits of creatine and negates the adverse effects.

cle uptake of creatine.

- Creatine's greatest drawbacks are its ionic nature and osmotic pull.
- Creatine's effects are further impeded by the use of active transport and the supposed downregulation of intestinal creatine receptors.
- Transit time may cause a variable delay in creatine delivery to the intestine for absorption.
- Effervescent delivery buffers creatine at its pI, which allows it to exist as a zwitterion.
- Effervescence also decreases transit time, providing a quicker and more reliable delivery to the intestine.
- Creatine as a zwitterion may be available for both active and passive transport, bypassing the reduced availability from receptor downgrading.
- Creatine causes a 10 percent increase over the AWP of control subjects.
- Creatine with carbohydrate causes a 20 percent increase over the AWP of control subjects; that is, it's twice as effective.
- Effervescently delivered creatine with carbohydrate causes a 30 percent increase over the AWP of control subjects; that is, it's three times, or 300 percent, as effective and 150 percent as effective as creatine and carbohydrate.

One further benefit of the effervescent creatine is that it is dose-measured in the individual packages, which means that each ingredient is added to each package individually to ensure that each serving contains the amount of each ingredient it's supposed to contain. That's in contrast to the large tubs of batched products, like the creatine-and-carbohydrate blends. The mixing process is imprecise, and settling occurs during both manufacturing and shipping. Creatine may be nearly nonexistent in one portion of the batch and over the stated amount in another. The effervescent system also requires a foil-sealed pack, which provides for a longer shelf life and fewer storage-related changes, and the individual serving packs make it more convenient to use.

Effervescent creatine represents a novel and effective use of a pharmaceutical delivery system that enhances the positive benefits of creatine and negates the adverse effects.

Editor's note: Daniel Gwartney, M.D., is a clinical pathologist and a graduate of the University of Nebraska College of Medicine. He's been bodybuilding for more than 18 years.

Effervescent Creatine: How It Ignites Size and Strength

by Steve Holman

Effervescent Creatine Elite is a natural, legal compound that can increase your work capacity for building muscle by almost 200 percent over what you get with powdered creatine monohydrate. It uses the same effervescent technology that enhances the delivery of many oral medicines, a technology that's rapidly becoming the standard in bodybuilding supplementation. This revolutionary method of getting nutrients and/or drugs into the bloodstream produces startling results, as the latest creatine research shows.

Jeffery Stout, Ph.D., a renowned strength researcher, performed a study involving effervescent creatine at Creighton University's Exercise Science Research Laboratory in Omaha, Nebraska. Using a test that simulates weight training, he compared anaerobic work capacity of subjects taking the following:

- 1) Creatine monohydrate
- 2) Creatine monohydrate plus carbohydrates, which, based on other studies, has been the premier creatine transport solution for years
- 3) The new effervescent creatine
- 4) A placebo

The preliminary findings are stunning. The effervescent creatine didn't just produce a slight increase; it ramped up work capacity by an unbelievable 194.9 percent over creatine monohydrate and 84 percent over creatine plus carbs. In other words, powdered creatine plus carbs will have to give up its crown as the ultimate transport system. The reason effervescent creatine is almost two times as effective as the current creatine-transport champ is its amazing 100 percent absorption.

For many people standard creatine can cause severe gastrointestinal distress, including painful cramps and diarrhea, a direct result of poor absorption. Even if you don't get cramps, you're probably not absorbing more than one or two grams, according to recent research. Powdered creatine isn't soluble in water, so efficient absorption of a powdered form is impossible for most people. Effervescence solves the problem.

Effervescent Creatine Elite is a combination of creatine monohydrate, potassium bicarbonate and citric acid powders. Once that combination hits water, the reaction between the bicarbonate and the citric acid produces the effervescent effect. That disassociates the creatine from its salt—the monohydrate—so what you get is a powerful free-ionized creatine ready to flood your bloodstream and infuse your muscle

structures with the ability to generate new power.

Free-ionized creatine is soluble and dissolves completely in water. That means no grit. Once you drink it, it goes to the stomach, where the solution manipulates the pH, or acidity level. That has two effects: 1) It strips the creatine molecule of its ionic co-electrical charge so it's able to pass through the intestinal cell membrane, and 2) it causes the stomach to "dump" the creatine into the small intestine, where absorption actually occurs. Without the pH manipulation creatine is trapped in the stomach for as long as four hours, which can cause cramps. With pH manipulation, however, the absorption rate is pushed to almost 100 percent, a far cry from the meager 30 percent absorption most people get with powdered creatine. Imagine the kind of gains you can achieve when all of the creatine you take is actually absorbed and is readily available for your muscle structures.

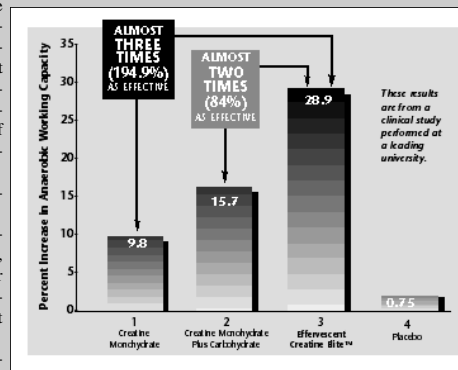
Other advantages of effervescence include the fact that its buffering action reduces the possibility of stomach distress and masks the harsh taste that's prevalent in standard powdered creatine products. With no harsh taste to deal with, the manufacturer only

adds a small amount of orange flavoring—and it tastes delicious. It also has 18 grams of dextrose to further speed creatine transport to the muscles.

Effervescent Creatine Elite comes in individual foil pouches, five grams of creatine in each, so you can't make a mistake on dose. All you do is tear open the packet, pour the contents into 16 ounces of water, watch it fizz for 15 seconds and drink it down. The creatine enters your bloodstream in a matter of minutes—not just 20 to 30 percent of the muscle-cell volumizer but almost 100 percent. There's absolutely no waste. That means you get much more size and power output from every dose. The manufacturer does recommend that you load with 20 grams for five consecutive days, as studies indicate that loading can increase total muscle creatine by more than 20 percent. The five-gram daily dose after the loading phase maintains the high concentration in your muscles.

According to Daniel Gwartney, M.D., "Effervescent creatine provides the majority of its creatine load through passive transport as well as by using creatine-specific receptors. That means it gives you a greater loading effect and can provide greater performance benefits for longer periods."

If you're looking for a true muscle-volumizing supercompound, try Effervescent Creatine Elite. It's a serious breakthrough for serious gains—in size, strength and power.



Breaking Barriers

by Daniel Gwartney, M.D.

Creatine monohydrate is clearly the most effective strength- and performance-enhancing supplement ever developed. So, why has it been getting such a bad rap? That's easy. It's the same reason that so much of it gets left in your glass: Creatine doesn't dissolve well in water, and that can cause a number of problems.

Many athletic trainers and strength coaches don't allow their athletes to use creatine at all because of the associated cramping, diarrhea and dehydration that have been reported. I, along with several colleagues, have consulted and advised many athletes and teams. Sometimes these problems go away after hydration is forced on the athletes. Reducing the dose has also helped—four five-gram servings a day for five days, then one five-gram serving per

day after that. We've also found that it helps to take creatine first thing in the morning rather than within an hour of an intense practice.

For some people the above may provide the full benefit of creatine supplementation; however, there are other problems. The cramping, diarrhea and dehydration are typically due to the creatine's being retained in the intestines. That causes the body to flush water through the intestines, drawing it away from the bloodstream and muscle. As you can imagine, all that water rushing into the intestines usually leads to its rushing out again. So merely providing extra water doesn't solve the problem, as many people still experience diarrhea due to the excess water in the gastrointestinal tract.

Could the addition of carbohydrates, phosphates, ATP and/or insulin mimickers help? No. Some of those agents are useful when the creatine reaches the muscle, but they do nothing to alleviate the first and worst problem—lack of absorption.

The reasons that creatine doesn't dissolve in water have to do with the biochemical nature of the creatine molecule, the environment in the digestive tract and the transit time, meaning the time it takes for creatine to pass to certain parts of the G.I. tract. You can see for yourself that

it doesn't dissolve. Fill a clear glass with water and dump in your five grams of creatine. Let it sit for a minute or five minutes or an hour. What do you see at the bottom? About 3.5 grams of creatine. If you think sugar helps, put a tablespoon or two in the same glass. The white mountain at the bottom of the glass will grow. Go ahead and shake it like one of those Christmas globes with the snow scenes. The creatine won't dissolve.

After that experiment you should realize the consequences of taking this supplement. As mentioned above, when the creatine sits in your gut undissolved, water floods the area in an attempt to break up the particles that are irritating the intestines. That may seem like a small problem—until you realize that it can pull in nearly two quarts of water. I don't know about you, but if I'm going for a record squat, I don't want two quarts of water in my bowels.

Even if the creatine does eventually get enough water to dissolve, that will probably occur too late. The majority of creatine absorption takes place in the first part of the intestine, the duodenum, immediately after passing through the stomach. That area is designed for maximal absorption. Unfortunately, the water gets to the intestines much farther down the G.I. tract, in your colon, right before the exit chute and far from the area of maximum absorption.

It's important for the creatine to be dissolved because only dissolved creatine can be absorbed. The absorption can take place either by active transport, which requires energy and a creatine-specific receptor, or by passive transport, which doesn't. To put it another way, creatine can either float through the gut into the bloodstream or be picked up and dragged across the gut into the bloodstream.

Traditional creatine is only about 30 percent dissolved when you swallow it, so at most only about 1.5 grams are available for delivery. Contrast that with the new effervescent creatine, which is nearly 100 percent dissolved when you drink it, and you see the obvious superiority. With effervescent creatine all five grams are available for delivery. That means no more creatine-associated dehydration, diarrhea or cramping.

Effervescent creatine is also far superior when it comes to transport across the intestinal cell membranes. Creatine has ionic regions. Parts of the molecule have electric charges, like static electricity, and those ionic regions prevent creatine from passing through the intestine without the use of energy to counteract the electrical repulsion. If the creatine molecule is electrically balanced, or neutral, it's called a zwitterion and it can pass through the membranes of the intestine without having to use the receptors for extra energy. That's exactly what effervescent creatine accomplishes. It stabilizes the gastric environment, meaning the stomach and intestines, so the creatine molecules exist as zwitterions.

In traditionally delivered creatine the ionic regions are intact. They create an electrical charge, which requires the use of the creatine-spe-

Traditional creatine is only about 30 percent dissolved when you swallow it, so at most only about 1.5 grams are available for delivery. Contrast that with the new effervescent creatine, which is nearly 100 percent dissolved when you drink it, and you see the obvious superiority.



Effervescence decreases gastric transit time, so the creatine doesn't sit in your stomach and get chewed up by the acid there. It passes quickly to the duodenum for rapid availability.

cific receptors. If the receptors were available in unlimited supply and never downregulated, there wouldn't be a problem. (Downregulation occurs when an excess of a hormone or other agent causes fewer receptors to be available.) Unfortunately, there's a limited supply of creatine receptors and they're downregulated during creatine supplementation. So, if creatine is delivered via active transport, as traditional creatine is, it becomes less efficiently absorbed over time. Less and less creatine is available for the muscles, which means a decrease in performance. The only options available for maintaining increased bioavailability are intravenous administration—yes, needles—or creatine delivered through passive transport. Effervescent creatine provides the majority of its creatine load through passive transport as well as by using the creatine-specific receptors. That means it gives you a greater loading effect and can provide greater performance benefits for longer periods.

Transit time is another very important issue. Effervescence decreases gastric transit time, so the creatine doesn't sit in your stomach and get chewed up by the acid there. It passes quickly to the duodenum for rapid availability.

Effervescent Creatine Elite recently proved its superiority in a study performed by Jeff Stout, Ph.D., an assistant professor of exercise science at Creighton University in Nebraska. I know Jeff, and I've read many of his published studies. He's one of the best researchers in the field and has a wealth of knowledge.

Jeff's study analyzed anaerobic work capacity, or AWC, in several groups of athletes. AWC is a measure of how much high-intensity work a muscle can perform without rest, and that's the type of performance creatine enhances. The groups in the study included a placebo, or control, group; a powdered-creatine group; a creatine-carbohydrate-blend group and an effervescent-creatine-and-carbohydrate-blend group. The results were significant—and not just by some mathematical formula.

The placebo group had no change, as would be expected, since the subjects received no active supplement. The subjects in the powdered-creatine group increased their AWCs by 10 percent, those in the creatine-plus-carbs group increased by 20 percent, and the effervescent-creatine-and-carbs group showed an almost 30 percent increase—that's like getting three extra reps on your 10-rep bench press. Based on those results, effervescent creatine provides nearly 300 percent of the benefits of powdered creatine and 150 percent of the creatine-carb blends, and its performance-enhancing effects should also last much longer due to less downregulation of the creatine receptors.

I hate to be the one to break the news to the old guard, but while creatine is still king, it's riding higher on the shoulders of effervescent delivery. Effervescent creatine is truly a breakthrough bodybuilding supplement.

Creatine Q&A

Q: Do I have to load effervescent creatine the way I do other creatine products?

A: Yes, you should perform a standard loading phase, using 20 grams of creatine a day for five days, and spread that dosage throughout the day so you get five grams at four different times. If you're using Muscle-Link's Effervescent Creatine Elite, that's four packets a day, which means one 20-packet box will take you through your five-day loading phase.

Q: I eat six meals a day, so how do I load if every dose has to be taken on an empty stomach?

A: Take your effervescent creatine about 30 minutes before a meal. Also, it's best to use effervescent creatine 1 1/2 hours or more after a meal—preferably a protein drink rather than solid food, as protein drinks tend to leave your stomach faster.

Q: Why does my stomach have to be empty?

A: Effervescent creatine manipulates the pH of your stomach so that it immediately dumps the solution into your small intestine for maximum absorption. If food is present, the pH of your stomach will be impossible to manipulate due to stomach acid, and the creatine solution could remain in your stomach for hours, severely diminishing absorption. When your stomach is empty, on the other hand, it perceives the effervescent creatine as digested food and immediately moves it to the small intestine, where it's almost 100 percent absorbed in about 20 minutes. Compare that to the inefficient 30 percent absorption you get with standard creatine, and you see why effervescent creatine has been shown to produce almost three times the results.

Q: Can I get complete absorption with standard powdered creatine products if I use them on an empty stomach?

A: No. The primary problem with standard creatine is its inability to dissolve. That's why you see it settle at the bottom of a glass. It does the same thing in your gut, even if your stomach is empty. According to Daniel Gwartney, M.D., what happens after you swallow powdered creatine can be a painful experience: "Cramping, diarrhea and dehydration are typical due to the creatine's being retained in the digestive tract. When the creatine sits in your gut undissolved, water floods the area in an attempt to break up the particles that are irritating the intestines. That may seem like a small problem—until you realize that it can pull in nearly two quarts of water. I don't know about you, but if I'm going for a record squat, I don't want two quarts of water in my bowels."

Q: Can't I just mix powdered creatine with Alka-Seltzer and get the same effervescent effect?

A: That may sound like a plausible plan, but, unfortunately, it doesn't work. Effervescent delivery is specific to the compound or medication that's being administered. In fact, Fortress Systems has a patent on creatine delivery in an effervescent form. That should tell you that the effervescence for delivering creatine is different from the effervescence that delivers the medications in Alka-Seltzer. The delivery system designed for creatine separates the monohydrate, or salt, from the creatine, creating a highly absorbable zwitterion. If you take powdered creatine with Alka-Seltzer, you may get somewhat less stomach distress, but the absorption of the creatine will still be low—probably around 30 percent—because it's still plain old powdered creatine monohydrate, and your intestines will no doubt still react unfavorably to the undissolved granules that irritate its lining.

Q: Can effervescent creatine help improve my weak bodyparts?

A: Yes, in fact, many bodybuilders are using an extra packet of effervescent creatine immediately before training a weak bodypart so they get rapid creatine uptake by that specific muscle group. Remember, effervescent creatine enters your bloodstream fast, in about 10 minutes, so if you take it right before you train a bodypart, as you work and deplete the muscle, it should immediately suck up any creatine that's pumped into it via the circulatory system and repetitious exercise.

For example, say your chest is your lagging bodypart. On chest day simply use an extra packet of Effervescent Creatine Elite about 10 minutes before your first warmup set. As your chest workout progresses,

A number of athletes have reported increases of as much as 30 pounds on their bench press one-rep maxes after only five days and bodyweight gains of 10 pounds in four weeks.

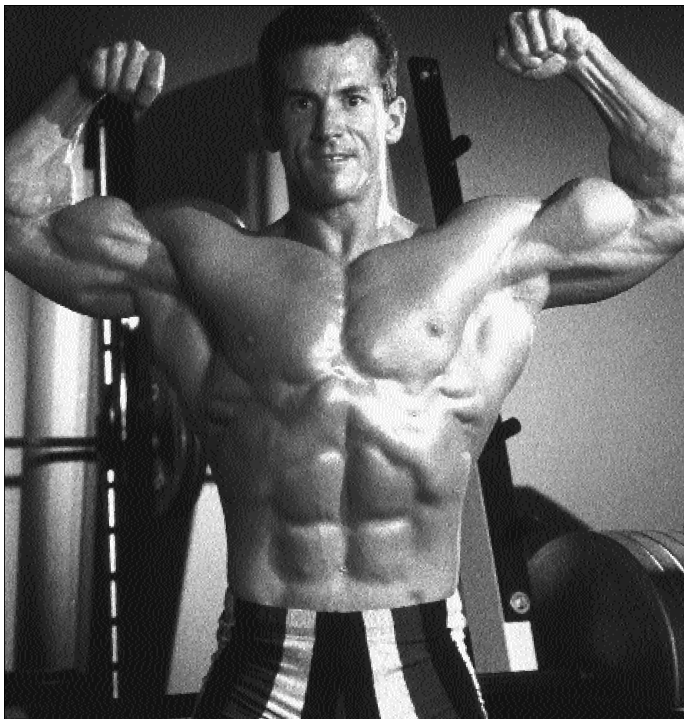
so does absorption of the effervescent creatine, and as your pecs are engorged with each successive set, much of the newly available creatine goes right where you need it, into the muscle cells of the pec major and minor.

Q: What kind of results can I expect with effervescent creatine?

A: If you use a proven brand, such as Muscle-Link's Effervescent Creatine Elite, you should get an immediate increase in size and strength after the loading phase, even if you've been using standard creatine. A number of athletes have reported increases of as much as 30 pounds on their bench press one-rep maxes after only five days and bodyweight gains of 10 pounds in four weeks.

Q: If I'm using standard creatine with no problems and I'm getting decent gains, should I still try effervescent creatine?

A: If you were driving around in a backfiring '74 Volkswagen Rabbit, would you spend a few extra pennies to move up to a precision-tuned Porsche? You'd be riding in greater comfort and getting to where you were going a lot faster. Remember, most people only get about 30 percent absorption with standard creatine, even when using the creatine transports. With effervescent creatine, however, you get almost 100 percent absorption. Imagine how much better your gains will be when you're getting an



entire five-gram dose into your bloodstream as opposed to a meager gram or two. Once you try it, it will be obvious that effervescent creatine is the Porsche Carrera of creatine products.

—Steve Holman, editor in chief, IRONMAN

Q: Are there any study results on Effervescent Creatine Elite vs. liquid creatine? I've read many reports on effervescent creatine vs. creatine monohydrate, creatine monohydrate plus carbohydrate and a placebo, but nothing about studies comparing it to liquid creatine.

A: The studies that have been completed, as well as the studies that are in progress, compare effervescent delivery of creatine to the unaided absorption of creatine, either with or without a carbohydrate source. The effervescent delivery has been shown to aid in tolerance, compliance, reduction of adverse effects and improved performance enhancement.

Powdered creatine monohydrate as well as creatine-and-carbohydrate blends have been used as the reference groups for two primary reasons:

1) Both creatine monohydrate and creatine-carbohydrate blends have been extensively studied, and the effects, proper testing methods and reliability have been well established.

2) Creatine monohydrate powder and creatine-carbohydrate blends represent a very high percentage of the creatine market share.

So-called liquid creatine preparations are not dissolved creatine. They're suspensions of creatine in a gel, typically aloe vera or a glycol base. Suspension is a word that describes particles floating in liquid, whether it be water, glycol, aloe vera or any other fluid. Placing the creatine in liquids other than water doesn't benefit the delivery of creatine because the body will only absorb creatine in the water-soluble form. Failure to split the hydrate salt to free the creatine does nothing for the delivery of the creatine. It's because the creatine is present as a suspension that the directions call for vigorous shaking. In addition, there's concern about the possibility of bacterial growth in many of the liquid creatine preparations.

In a pilot study performed for one of the liquid creatine companies, the liquid creatine preparation was shown to be less effective in terms of performance benefits than powdered creatine (without carbohydrate). Obviously, the company chose not to use the results of that study in any marketing literature. As liquid creatine doesn't represent any benefit over powdered creatine and does not hold a significant market share, there was no justification for including any liquid creatine preparation in any of the studies.

—Daniel Gwartney, M.D.

Q: I just heard about an effervescent creatine with a lot more simple carbs in it than Effervescent Creatine Elite. The company says the sugar makes its effervescent creatine better because you get more insulin in your system, and insulin forces more creatine into the mus-

Placing the creatine in liquids other than water doesn't benefit the delivery of creatine because the body will only absorb creatine in the water-soluble form. Failure to split the hydrate salt to free the creatine does nothing for the delivery of the creatine.

Is there a way to take greater advantage of insulin's creatine-uptake-increasing ability using Effervescent Creatine Elite without derailing the reaction and absorption? You bet! Try chasing Effervescent Creatine Elite with a high-glycemic-index juice about 20 minutes after you take it.

cles. Is that true?

A: The first thing to realize is that it's probably not real effervescent creatine. A lot of simple carbs will diffuse the reaction and derail absorption. If you're using real effervescent creatine and you want the best effects, you have to take it on an empty stomach so that the solution can shift from the stomach to the intestinal tract immediately and be 100 percent absorbed. A lot of sugar can prevent that from happening, which is the very reason Effervescent Creatine Elite has 18 grams of dextrose, enough to provide insulin output but not enough to derail the effects of effervescence.

The company you're referring to is no doubt selling regular powdered creatine in a fizzy sugar solution and trying to pass it off as effervescent creatine. It's essentially a bubbling creatine transport concoction. In the study done by Jeff Stout, Ph.D., effervescent creatine proved to be almost 100 percent more effective than creatine transports. Keep in mind that with a creatine transport, you're just getting plain old creatine, which is only about 30 to 40 percent absorbed. With Effervescent Creatine Elite you get free-ionized creatine that's almost 100 percent absorbed.

Also, Stout and Dr. Dan Gwartney believe that with powdered creatine, whether it's in a transport mix or not, the compound peaks at about 90 minutes. It takes that long because the creatine granules sit in your stomach as your system attempts to dissolve them—most not getting absorbed. Insulin, on the other hand, peaks at 10 to 20 minutes, so the two peaks miss each other by more than an hour.

If the creatine and insulin peaks miss each other, why do creatine transports, with their insulin-triggering capabilities, work better than standard powdered creatine? Because although you're past the insulin peak when you reach your creatine peak, a bit of insulin remains, so you do get somewhat more creatine into the muscle thanks to its nutrient-shunting ability.

Is there a way to take greater advantage of insulin's creatine-uptake-increasing ability and the awesome power of Effervescent Creatine Elite without derailing the reaction and absorption? You bet! Try chasing Effervescent Creatine Elite with a high-glycemic-index juice about 20 minutes after you take it.

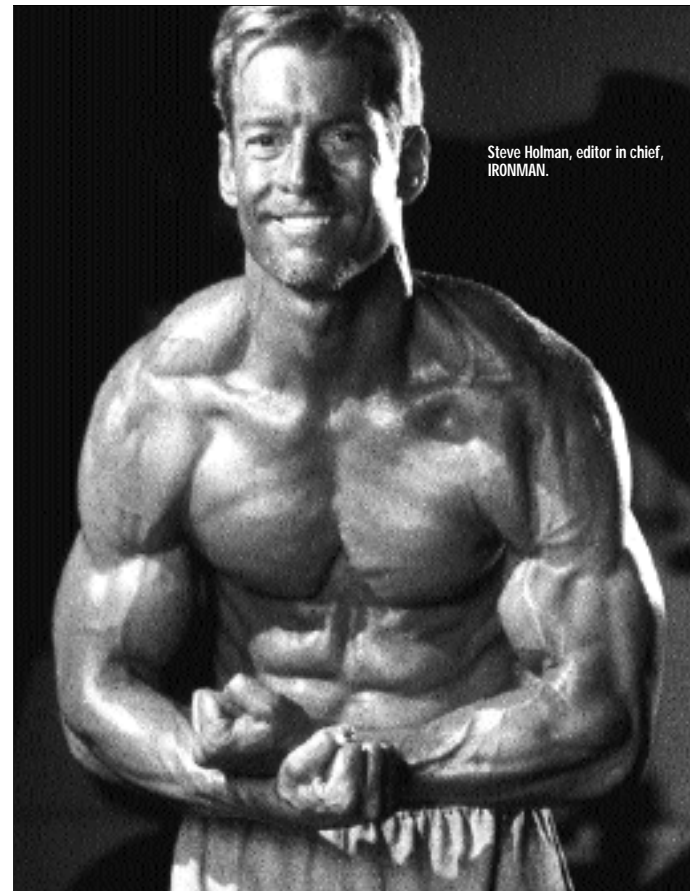
Here's why it works: Once you take Effervescent Creatine Elite, 100 percent of the creatine will be available for absorption at the 20-minute mark. At that point the high-glycemic drink, such as 12 to 16 ounces of grape juice, won't interfere with the reaction or absorption; however, it will give you an insulin surge and peak after another 20 minutes—while all of the creatine is still coursing through your bloodstream and starting to enter your muscle structures. The peaks coincide almost exactly.

Will the extra insulin force more of the free-ionized creatine into your muscles? Insulin does seem to help the creatine transports work a little better than standard powdered creatine, so based on that, the an-

swer appears to be yes. Perhaps if the subjects who were taking Effervescent Creatine Elite in Stout's study had used the above procedure, they would have gotten even more spectacular results. By precisely timing your effervescent creatine and insulin-triggering solution, you can create the perfect environment for heightened size and strength gains—better than any other creatine supplement on the market, bar none.

By the way, all the effervescent creatines on the market were just tested, and FSI's product, which is marketed by Muscle-Link as Effervescent Creatine Elite, is the only one that produced free-ionized creatine, the key to optimal absorption. It's the real deal, unlike the other knock-off products out there. Don't be fooled.

—Steve Holman, editor in chief, IRONMAN



Steve Holman, editor in chief, IRONMAN.

Keep in mind that with a creatine transport, you're just getting plain old creatine, which is only about 30 to 40 percent absorbed. With Effervescent Creatine Elite you get free-ionized creatine that's almost 100 percent absorbed.

Ribose: The Key to Cellular Energy

by Jerry Brainum

On an elemental level, all the size and strength gains you can possibly make come down to one thing: energy. While it's obvious that you won't be able to train with maximum intensity if you don't feel energetic, you'll also make less bodybuilding progress because of the lack of cellular energy available. Your body needs cellular energy to power such essential reactions as glycogen and protein synthesis within muscle, as well as innumerable other biochemical recovery reactions that occur after exercise.

The most elemental energy source in the body is a compound called adenosine triphosphate, or ATP. The adenosine portion is made up of one molecule each of adenine and a five-carbon sugar, or pentose, known as ribose. As the name implies, the triphosphate portion of ATP consists of three phosphate molecules. When one of those phosphates is broken off from ATP, energy is released and the compound becomes adenosine diphosphate (ADP), which consists of adenosine (including its ribose base) and two phosphate molecules.

All sources of food energy—carbohydrates, fats and proteins—are eventually converted into ATP in the parts of the cell called the mitochondria. Every move you make and every chemical reaction that occurs in your body is powered by ATP.

Nevertheless, the body's stores of ATP are quite limited—about three ounces, or 90 grams. That's enough to supply maximum energy for all of 10 seconds. The body works around the limited ATP storage by using various recycling mechanisms. For example, after a phosphate bond is split from ATP, releasing tremendous energy and leaving ADP, the body, through a series of quick enzymatic reactions, adds a phosphate to the ADP to re-form ATP. That process works efficiently in the presence of oxygen, or aerobic metabolism, using fats and glucose as substrates, or starting molecules.

The situation changes during periods of decreased oxygen availability, or anaerobic metabolism, which is the type of energy cycle used in high-intensity training, such as bodybuilding

workouts. Under those conditions the cells get their donated phosphate for re-forming ATP from creatine phosphate stored in muscle. That explains the primary ergogenic effect of creatine as a food supplement. It acts as a second battery in cells to help reconvert ATP by passing over a phosphate molecule. Even though the system sounds efficient, however, the ATP-creatine energy cycle can only supply about 30 seconds of maximum energy, as the creatine is rapidly used up under such conditions.

When that happens, the body relies on still another energy pathway to help resurrect ATP, a system called the myokinase reaction after the enzyme that catalyzes it. It involves using two molecules of ADP and one molecule of AMP, or adenosine monophosphate, which contains just one phosphate molecule, to form one molecule of ATP. The myokinase reaction helps supply necessary ATP when the creatine stores aren't sufficient. The reaction also balances ATP and ADP levels in the cell.

While the myokinase reaction helps to keep the cellular motor running, a problem arises because of the buildup of AMP in the cell. The body deals with it by turning on other enzymatic reactions that downgrade the AMP, which is then eliminated from the body. The problem is AMP's role as a substrate in the recirculation of ATP. If it's eliminated, the existing ATP stores may not be sufficient to supply maximum energy.

Once again, the body has ways of dealing with the problem. Two primary pathways exist to help use AMP in the creation of ATP. One is called the salvage pathway, a system in which the body tries to salvage AMP breakdown products. The good news is that when it works, it works well in helping to maintain ATP stores. That's where ribose enters the picture. Ribose promotes this more efficient salvage pathway, thus allowing better ATP recycling and consequent increased muscular recovery after training.

If the body doesn't use the salvage pathway—for example, when ribose is insufficient—it must



The cells make the conversion whenever PRPP is needed, but, once again, under conditions of strenuous exercise or poor blood circulation (as in cardiovascular disease) the PRPP stores are used up in the salvage or de novo pathways. Using supplemental ribose maintains PRPP, which in turn maintains the ATP salvage pathway. So the real limitation is the availability of ribose.

In truth, the body can synthesize PRPP from glucose, but it's a long, slow process that may take several days. In the meantime the existing muscle ATP stores aren't sufficient to support maximal energy for high-intensity exercise or sports. Ribose is made from glucose in a process called the pentose phosphate pathway, which metabolizes glucose into ribose-5-phosphate. That, in turn, is converted into the active PRPP. Taking supplemental ribose bypasses the two rate-limiting enzymes in the pentose phosphate pathway, leading to quicker production of PRPP, which helps to conserve nucleotides, or AMP metabolites, essential for ATP synthesis.

make ATP from scratch in a pathway called the de novo, or new, pathway. That occurs when the body has excreted too much of the metabolic by-products of AMP that serve as precursors for ATP. While having enough ribose available favors the more efficient salvage pathway, the fact is that ribose is also required for the de novo pathway.

Both processes begin when ribose is converted into a molecule called 5-phosphoribosyl-1-pyrophosphate (PRPP).

Another vital use of ribose is in the formation of nucleotides, which, in turn, are needed for energy production; for synthesis of protein, glycogen and nucleic acids; and for the formation of cyclic nucleotides, such as cyclic AMP, a substance that is needed for fat oxidation and hormone-cell interactions.

Taking supplemental ribose increases ATP manufacture in skeletal muscle by 340 to 430 percent. In the ATP salvage process supplemental ribose increases the cell's ability to reuse ADP and AMP by up to 700 percent.

The enzyme that controls the conversion of glucose into ribose is glucose-6-phosphate dehydrogenase (G-6-PDH). The problem is that the supply of it in both skeletal and heart muscle is low. Even so, using supplemental ribose bypasses the enzymatic process, enabling the ribose to take an express route directly to the active substance that promotes ATP recovery, PRPP. The bottom line is faster and more efficient restoration of ATP stores in the body.

Since the body only contains about 1.6 milligrams of ribose for every 100 milliliters of blood and since most foods, such as meat products, contain barely discernable amounts of it, you can clearly see the necessity of taking extra ribose.

The body uses ribose in several important ways. It's used to make glucose, the most elemental sugar in the body, which circulates in the blood. Ribose may also be enzymatically converted into pyruvate, which enters the cell in an energy-producing process using oxygen that's called the Krebs's, or citric acid, energy cycle. Still another vital use of ribose is in the formation of nucleotides, which, in turn, are needed for energy production; for synthesis of protein (i.e., messenger RNA), glycogen and nucleic acids (RNA and DNA); for enzymatic control of electrolyte metabolism; and for the formation of cyclic nucleotides, such as cyclic AMP, a substance that's needed for fat oxidation and hormone-cell interactions.

Ribose is used in the manufacture of the B-complex vitamin riboflavin, or vitamin B2, which among other things makes your urine bright yellow. Ribose is also used in the manufacture of several antiviral drugs, such as Ribavirin, which prevents virus replication by inhibiting RNA and DNA synthesis.

Taking supplemental ribose increases ATP manufacture in skeletal muscle by 340 to 430 percent. In the ATP salvage process supplemental ribose increases the cell's ability to reuse ADP and AMP by up to 700 percent.

Although scientists have been aware of ribose metabolism since 1930, its importance didn't become apparent until the 1950s. Since then ribose research has burgeoned, having mostly to do with the effect of ribose protection against cardiovascular problems. When the heart doesn't get enough blood flow, a condition called ischemia, or when it's under low oxygen conditions, or anoxia, ATP stores in the heart are rapidly degraded. The heart's inability to rapidly restore the ATP loss leads to a buildup of AMP in the heart. Many studies have shown that supplying supplemental ribose restores ATP in the heart. A forthcoming study from the University of Maryland uses ribose to treat cardiac ischemia, which is typically manifested as the pain of angina pectoris in people suffering from coronary artery disease.

In fact, any disease that results in decreased blood flow to tissues and subsequent lowered oxygen delivery can lead to a depletion of ATP. That can cause symptoms of severe pain, cramping, stiffness and soreness. In one genetic enzyme deficiency called myoadenylate meami-

nase deficiency (MADD), muscle cells cannot conserve nucleotides. When that happens, AMP is degraded to inosine and hypoxanthine and leaves the body. The lack of ATP substrates makes a person suffering from MADD very weak, with stiff, sore muscles.

The same lack of adequate blood flow and oxygen can temporarily occur during intense muscular contractions, again leading to a loss of the nucleotides needed to rebuild ATP in the cells. When that happens, you won't feel fully recovered from workout to workout, and your strength gains will suffer. Research shows that the loss of vital nucleotides during intensive exercise can be as high as 20 to 28 percent. Most of such loss occurs during anaerobic exercise, since the high oxygen levels typical of aerobic exercise conserve nucleotides.

At present more than 150 peer-reviewed published studies attest to the fact that ribose effectively increases ATP and total nucleotide (TAN) recovery while improving performance in heart and muscle cells during periods of lowered blood flow or low oxygen. Those conditions can occur in the heart with coronary artery disease or during certain surgical procedures. As noted above, ischemia can also occur during intense anaerobic exercise.

Several studies have illustrated the severity of nucleotide loss during either intense exercise or ischemia. A Swedish study focused on two groups of exercising men, in which 11 healthy men performed high-intensity exercise three times a week for six weeks, followed by another week of twice-daily sessions. Another group of nine men rested for the first six weeks, then trained twice a day with the first group during the final week.

Muscle biopsies, which are small bits of muscle tissue taken for analysis, showed that ATP levels in the thigh muscles of the first group

Peak power was 9.9 percent higher and mean, or average, power was 9 percent higher in the subjects who took the actual ribose supplement. Muscle biopsy of the subjects showed that those taking the ribose more effectively used their energy stores and recovered quicker after exercise.



Ribose supplements are particularly synergistic with creatine, which works by supplying a phosphate molecule after ATP is broken down to ADP to release energy.

dropped 13 percent during six weeks of training but did not decrease further during the final week of twice-daily sessions. Even after three days of rest ATP still hadn't returned to pretraining levels in the muscles of the first group and was 10 percent lower than the pretraining levels.

In the second group ATP levels dropped 25 percent right after the final workout. Even after three days of rest those men still showed ATP levels that were 19.5 percent less than when they started. This study showed that ATP levels dropped considerably with exercise and were not restored in the trained muscles even after three days of rest. Another study showed a 19 percent drop in muscle ATP levels after seven weeks of sprint training.¹

Still another study showed that perfusion, or supersaturation, of skeletal muscle with ribose for 30 minutes increased de novo synthesis of nucleotides by 340 to 430 percent, depending on which type of muscle fiber was tested.² A more recent study done by scientists from the University of Missouri is being presented at the 1999 meeting of the American College of Sports Medicine. It examined the role of ribose in the adenine nucleotide salvage pathway and involved mixed plantaris, or leg, muscles in rats. The results showed that providing ribose to the exercising rats—who did anaerobic exercise, which leads to the greatest breakdown and loss of nucleotides needed for ATP synthesis—led to a significant increase in nucleotide salvage. For example, the dose that some rats received, which translates to a human dose of 2.5 grams of ribose, led to a 244 percent increase in nucleotide salvage over baseline, and an amount that translated to a human dose of 15 grams led to a whopping 639 percent increase.

Another new, unpublished study from Ball State University in Indiana investigated the use of supplemental ribose on performance and recovery during and after high-intensity exercise. As noted above, previous reports showed that it takes as long as 72 hours to significantly restore ATP and TAN after intensive exercise.

In the new study two subjects took ribose and another two took a placebo, or inactive substance, in this case glucose, for three days before doing sprint cycling for three days of two sessions daily. Each session consisted of 15 10-second sprints with resistance at 7 percent of body mass, with 50 seconds' rest between sprints. Both the ribose and placebo were given in three 10-gram doses.

The results showed that peak power was 9.9 percent higher and mean, or average, power was 9 percent higher in the subjects who took the actual ribose supplement. Muscle biopsies of the subjects showed that those taking the ribose more effectively used their energy stores and recovered quicker after exercise. They also showed greater recovery after 48 hours than the placebo group. The researchers believe that occurred because of increased de novo synthesis of adenine nucleotides in the ribose group. As you'll recall, ribose supplementation allows the body to bypass various slower enzymatic conversion processes.

The authors noted that while subjects took 30-gram doses of ribose, that amount is in excess of what's required to maintain optimal ATP and TAN levels. While the amount needed relates to activity and intensity of exercise, doses greater than or equal to 2.2 grams a day of ribose should maintain peak ATP and TAN levels. One researcher found that ribose may increase the salvage of nucleic acids by up to 700 percent!

These studies show that ribose can benefit anyone engaged in intensive exercise. A good daily dose is around three to five grams, and the more you train, the more you should take. Ribose is slightly sweet (it is, after all, a sugar) and can be taken in various forms. You should avoid using it in hot protein drinks, however, since ribose, when heated, may react with the amino acids in protein and lose effectiveness.

Ribose supplements are particularly synergistic with creatine, which works by supplying a phosphate molecule after ATP is broken down to ADP to release energy. But creatine doesn't replace the ATP that's lost during intense exercise. When there isn't sufficient ATP in the cell, creatine throws the phosphate ball, but there's no one to catch it. Adding ribose will help to conserve the vital adenine nucleotides needed to replenish ATP through both the more efficient salvage system and the slower de novo pathway. The net effect is that when you use creatine and ribose, you maximize cellular energy production.

Ribose should also increase the effectiveness of other supplements that require an optimal supply of ATP, such as pyruvate and carnitine, among others.

In terms of safety, doses of up to 60 grams of ribose have led to few complications. Some people who take in more than 25 grams per dose may get diarrhea, while others in rare cases experience mild, transient hypoglycemia, perhaps due to an insulin reaction. Most excess ribose, however, is simply excreted in the urine.

In the past the manufacture of ribose was an expensive process, which explains why it wasn't sold commercially. Now, however, a new company has developed a bacterial fermentation process involving the conversion of corn syrup, a form of glucose, that makes mass production of ribose simpler, so it can be sold at a reasonable price. Some types of ribose, though, may contain impurities in the form of contaminating sugars, such as arabinose or glucose, and other metabolites.

Based on its established metabolic attributes, ribose may well prove to be the next supplement superstar. Who knows—ribose may turn out to be the nutrient of the millennium!

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Ribose: Super Recovery and More Muscle Energy Through Creatine Synergy

It seems as if every time a new compound is released in the supplement marketplace, it's touted as the greatest breakthrough of all time. That can be a good thing, as it makes us all somewhat skeptical, but it can be a bad thing in that when a true breakthrough does come along, we miss it. "Yeah, yeah," we mutter as we turn the page, "another breakthrough."

If you said something similar when you saw the article on ribose by Jerry Brainum in this book, you may have glossed over a true supplement breakthrough that could change your workouts and recovery ability forever. Ribose may be the greatest supplement innovation since creatine—and that's not hype but fact backed by more than 150 peer-reviewed studies.

As you may or may not know, creatine works because it fortifies ATP, the compound your muscles use for energy. When you do a set, ATP is broken down rapidly, but creatine regenerates it by donating a phosphate to the depleted ATP (now ADP). The result is you get re-formed ATP and more anaerobic work capacity, which can result in more muscle growth stimulation. That's why creatine works.

Ribose also fortifies muscle ATP but through a different pathway—and perhaps even more critical, it bolsters muscle recovery after you train. Here's the way Brainum explained it: "Two primary pathways exist to help use AMP [adenosine monophosphate] in the creation of ATP. One is called the salvage pathway, a system in which the body tries to salvage AMP breakdown products. The good news is that when it works, it works well in helping to maintain ATP stores. That's where ribose enters the picture. Ribose promotes this more efficient salvage pathway, thus allowing better ATP recycling and consequent increased muscular recovery after training. If the body doesn't use the salvage pathway—for example, when ribose is insufficient—it must make ATP from scratch."

Making ATP from scratch is not a very efficient process and can compromise gains, so you don't want to be ribose deficient. Unfortunately, most hard-training bodybuilders are deficient because they don't get enough recovery time to regenerate ribose, which means they eventually run out of gas, plateau and more than likely fall victim to overtraining. One study showed almost a 20 percent drop in muscle ATP after only seven weeks of sprint training. Now imagine what happens to overall muscle ATP in bodybuilders after a few weeks of training all of their muscle groups. It's no wonder overtraining is so prevalent and the sport is filled with so-called hardgainers. (Perhaps hardgainers are simply not recovering due to ribose depletion.) Ribose supplementation could prevent that, or at least significantly slow the onset of overtraining by speeding the recovery process and ATP formation. Muscle biopsies of subjects taking ribose showed that they used their energy stores more effectively and recovered quicker after exercise. The hard numbers say that supplemental ribose increases ATP manufacture in skeletal muscle by 340 to 430 percent. In the ATP-salvage process supplemental ribose increases the cell's ability to reuse ADP and AMP by up to 700 percent. We're talking major muscle energetic upticks here along with a significant boost in muscle recovery between training sessions.

Brainum also discussed ribose's vital role in the formation of nucleotides, which are "needed for energy production; synthesis of protein (i.e., messenger RNA), glycogen and nucleic acids (RNA and DNA); enzymatic control of electrolyte metabolism; formation of cyclic nucleotides, such as the cyclic AMP needed for fat oxidation and hormone-cell interactions." Are you beginning to see the ribose-breakthrough connection?

Could ribose be the missing link that speeds recovery and puts an end to the hardgainer tag forever? Possibly. One thing is certain, however: All bodybuilders can benefit from better recovery and more efficient muscle energetics during a workout, and ribose is proving to be the new breakthrough in muscle regeneration supplementation as well as ATP-creatine synergy for more workout intensity.

—Steve Holman

Ribose Q&A by Jerry Brainum

Ribose could potentially be the most significant new food supplement since creatine hit the market about six years ago. Until now, ribose was only meaningful to biochemists and medical researchers. While it plays a pivotal role in the synthesis of adenosine triphosphate (ATP), the most elemental form of energy produced in cellular metabolism, and thus could have important effects on energy and exercise recovery, until recently the only research on ribose had to do with its use in treating cardiovascular diseases.

Now, however, a new process of ribose production makes it more readily available to consumers. While I covered the basics about how ribose works in the body and why it could have a significant effect in active people, such as athletes and bodybuilders, in the previous article, I didn't answer all the questions about this substance. To complete the picture about the practical use of ribose, I interviewed a man who is actively engaged in the marketing and research of it.

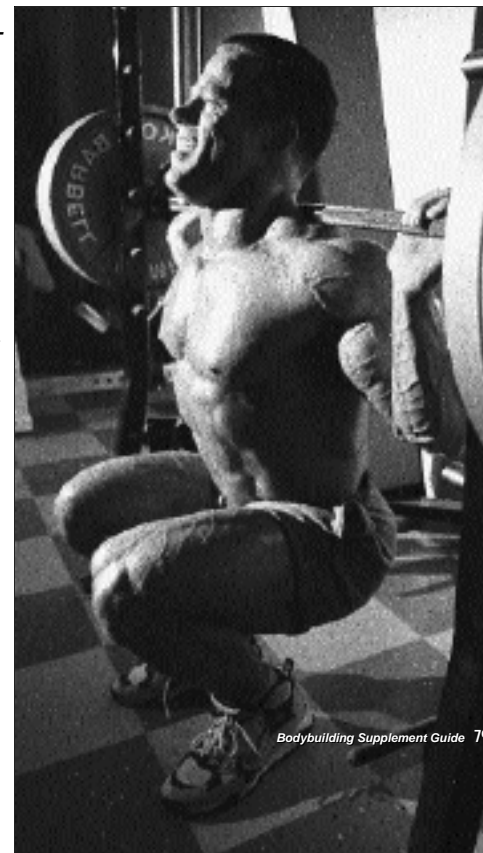
Clarence Johnson is the president and CEO of Bioenergy Inc., a company currently engaged in marketing ribose for public consumption. Besides being a business executive, Johnson has a solid scientific background. He has a master of science degree in microbiology from the University of Minnesota and has completed all but his defense of dissertation toward obtaining a doctorate in nutritional biochemistry.

Q: Since ribose helps the body produce ATP, why not just use direct ATP supplements?

A: ATP is a large and complex molecule not readily absorbed by the body. In addition, even if it could be efficiently absorbed, the ATP would not be shunted to tissues that are deficient in it. When tissues become energy depleted, they are, by and large, required to build their own energy stores.

Certain other adenine-nucleotide-pathway intermediates have been researched. Some are effective in increasing depleted energy stores. Adenosine, adenine, inosine, 5-amino-imidazoicarboximide riboside (AICAR) are some of the ATP precursors that have been marginally useful in increasing ATP regeneration following energy depletion. In fact, my company has a patent on the use of ribose plus adenine for energy production.

Most studies involving these compounds have been of short duration, and only partial ATP recovery occurred. Furthermore, ATP precursors that are relatively distant in terms of the enzymatic steps required to re-form ATP may be less efficient in inducing ATP recovery, while structurally related precursors like adenosine exhibit undesirable side effects, such as vasoconstriction (tightening of blood



Dr. Ronald Terjung and his colleagues showed that single doses as low as 2.2 grams were sufficient to increase nucleotide salvage after energy depletion by 177 percent over baseline. Single doses of 6.4 grams increase salvage by 536 percent of baseline.

vessels) and slowed atrioventricular conduction (a disturbance in normal heart rhythm).

Q: Since ribose is a sugar, wouldn't taking an oral ribose supplement result in its being metabolized directly to glucose?

A: The direct answer is no. Research conducted with 3H-labeled ribose has determined its metabolic route in the body. As quickly as five minutes to one hour following the appearance of ribose in the blood, it begins to appear in the cell nuclei of several tissues, including the liver, kidney, heart, skeletal muscle, smooth muscle and several others. Most of this ribose is directly metabolized to purines and pyrimidines, which are used for nucleic acid synthesis (mostly RNA) and nucleotides, such as ATP. RNA, of course, is required for protein synthesis, and the adenine nucleotides are used to build energy stores via ATP.

Some ribose is metabolized to glycogen in the cell cytoplasm (the space between the cell membrane and the cell nucleus). That's due to a flux of ribose up the pentose phosphate pathway (PPP) to glucose. The amount of ribose directed to this pathway is regulated by the requirements of the purine and pyrimidine pathways. Free ribose is first directed toward nucleotide and nucleotide biosynthesis, or nucleotide salvage, with flux up the PPP if an abundance of ribose is present.

A small amount of ribose is also metabolized to glycoproteins, which exist in many cellular secretions formed in the Golgi apparatus of cells. Those secretions may include pancreatic secretions, mucous and certain lipids, or fats; however, the glycoprotein secretions aren't relevant to the role of ribose in heart and skeletal muscle.

Q: What's the suggested optimum daily dose of ribose for athletic or exercise purposes, and what's that dose based on?

A: Scientists have worked out the dose-response kinetics describing the role of ribose in adenine nucleotide salvage. For example, research conducted by Dr. Ronald Terjung and his colleagues showed that single doses as low as 2.2 grams were sufficient to increase nucleotide salvage after energy depletion by 177 percent over baseline. Single doses of 6.4 grams increase salvage by 536 percent of baseline. In another study, Terjung's group determined that a single dose of 6.4 grams increased the synthesis of new adenine nucleotides in skeletal muscle by 340 to 430 percent, depending on muscle fiber type.

In a pilot study conducted at Ball State University in Indiana, researchers found that doses of 30 grams daily, taken as three doses of 10 grams each, increased total power output, peak power output and mean power output by 9.5 to 9.9 percent. That study also showed two additional and interesting findings. First, total adenine nucleotide levels—that is, the sum of ATP, ADP and AMP—in athletes decreased by up to 39 percent after high-intensity exercise. In short, energy levels dropped significantly following hard training. Second, after 48 hours of rest the athletes given ribose showed an increase in both ATP and adenine nucleotides, and they recovered to 85 percent of preexercise baseline. Athletes not taking the ribose continued to lose both ATP and total ade-

nine nucleotides and, therefore, showed no recovery at all. That result is consistent with the findings of other researchers, who also found little or no recovery in adenine nucleotide pools even after three days of rest following intense exercise.

What, then, is the proper dose of ribose? At this point we don't know. More research is required, and Bioenergy is contracting with universities to continue those studies. We do know, however, that doses as low as 2.2 grams per day can provide beneficial effects, and higher doses may provide additional benefits.

At this point I'd suggest doses of three to five grams a day to maintain high levels of nucleotides in muscle. Higher doses may be taken to boost energy before and after high-intensity workouts or for competition. As a practical matter, though, I don't think it's necessary to take in more than 10 grams per dose. For best results I'd suggest taking a dose an hour or so before training and again 30 minutes after the workout. For maintaining ATP stores, it's best to take a single dose after a workout. More information on this will likely emerge with continuing re-



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search.

Q: What's the maximum safe dose of oral ribose supplements?

A: Research shows that up to 60-gram doses are safe. No one has yet examined doses higher than that. Such doses of ribose are not recommended, however. Dose levels greater than 20 grams may cause gastrointestinal discomfort and possibly diarrhea. That can happen with any carbohydrate consumed in single large doses.

In addition, high-dose ribose can lead to a slight, asymptomatic decrease in blood glucose levels. Some speculate that this is due to a mild insulin reaction that drives glucose out of the blood into tissues. The effect has occurred in studies involving dogs, but the human-based research isn't as clear at this point. Since athletes taking ribose will also likely get other carbohydrates, this effect should be of no particular consequence, since the carb ingestion will maintain blood glucose levels.

My company, Bioenergy, has obtained premarket clearance for sale of ribose as a supplement in doses of up to 20 grams. That would certainly be considered a safe dose.

Q: Are there any long-term studies examining the effects of ingesting oral ribose supplements?

A: Several studies have examined the safety of ribose supplementation and infusion. One involved giving 60 grams a day to a single subject for one year without incident. Bioenergy has conducted laboratory-animal safety studies and found ribose to be safe; however, there aren't any studies that have investigated very long-term ribose ingestion at any dose level.

Bioenergy is engaged in clinical trials using ribose as an injectable drug. They're being conducted under an Investigational New Drug submission with



the Food and Drug Administration (FDA) and are about to move into phase-three, or multicenter trials. That means ribose has passed the first two safety hurdles required by FDA standards.

Q: How long should people take supplemental ribose without a break?

A: Again, to maintain adenine nucleotide levels at their peak, I'd suggest taking at least a maintenance dose daily. Clearly, that can be lower with less strenuous activity and increased as exercise intensity goes up.

Q: Recent creatine studies indicate that creatine should be taken in cyclical fashion, due to possible decreased creatine absorption following a downgrade of a creatine-carrier system in the body. Does the same hold true for ribose; that is, should it also be cycled for best results?

A: Since uptake of ribose into cells occurs through facilitated diffusion and thus doesn't require any type of cellular carrier system, it need not be cycled. When a cell needs ribose, it will readily take it up. What must be adjusted is doses, which should be based on level of exercise intensity and frequency.

Q: Since ribose works by helping to preserve vital adenine nucleotides—that is, ATP precursors—why not just supplement them?

A: As I noted earlier in my explanation of why ATP itself isn't a useful supplement, various ATP precursors have been tested and found to be not as effective in helping to regenerate ATP as ribose supplements. The reason is simple: The limiting factor in salvage or synthesis of adenine nucleotides is a ribose compound called 5-phosphoribosyl-1-pyrophosphate, or PRPP, which must be present in sufficient amounts to drive the salvage and synthesis reactions. PRPP is essentially a ribose molecule with three phosphate groups attached. Supplemental ribose is the most direct route to production of PRPP in the cell.

Q: Are there any known medical contraindications to using oral ribose supplements, such as possible allergies or worsening of existing diseases? In short, are there some people who should not use this supplement?

A: Again, the only known side effects that have appeared thus far involved gastrointestinal problems such as diarrhea when large single doses of ribose were taken. However, anyone with hypoglycemia or a tendency to rapid changes in blood glucose levels should consult a physician before using ribose supplements.

Q: Some articles have warned against combining ribose with protein supplements. Is that correct?

A: There's confusion on that point. In a short book recently published about ribose, Edmund Burke, Ph.D., suggests that ribose not be taken with protein-containing compounds, such as various types of supplements. The reason Burke suggests that is simple: Ribose is known as a reducing sugar, which means that when it mixes with certain other compounds, it creates reactions that convert it into something else.

For example, when ribose is mixed with protein and heated, it forms

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what's called the Milliard reaction with amino acids contained in the protein. That's the same process that turns meat brown when cooked and provides the typical aroma of cooked beef. In this case the functional benefits of ribose are lost. If the protein isn't heated or cooked, however, the Milliard reaction doesn't occur.

So, if you keep a protein mixture cold, no problems occur in reaction to ribose. If, however, ribose is mixed with protein and warmed up, such as what happens when you leave a protein drink in the hot sun or a hot car, a Milliard reaction may occur, and the functional benefit of ribose may be lost.

Q: What's the best way to take ribose supplements? With carbs, with meals or on an empty stomach?

A: The best way to take ribose is probably with other carbohydrates or alone on an empty stomach. That would ensure maximum absorption. However, I'd suggest taking ribose an hour or so before and/or about 30 minutes after exercise. Cardiac research involving ribose shows that it improves performance when taken before and after stress. For long-term aerobic events, though, it may also be beneficial to use ribose during the event. Note that if used in this manner, a low dose is advisable to avoid an embarrassing side effect, such as diarrhea.

Q: How long does it take to feel the effects of a ribose supplement?

A: In our experience about 60 percent of the people who've taken ribose supplements actually feel an effect. Some say they just have more energy. Others believe they can train harder and longer. It usually takes about three or four days to get those feelings. I would emphasize, however, that the research suggests that everyone taking ribose will get a beneficial effect if he or she exercises hard enough to deplete adenine nucleotide pools. Users may not feel it, but ribose is still working to enhance their energy and recovery.

The biochemistry about this is quite clear. Adenine nucleotides decrease in all strenuous exercise under both aerobic and anaerobic conditions. If an athlete exercises hard enough to lower cellular energy charge, then ribose will assist in recovery. It's like a rapid recharge on a rechargeable battery.

Q: What beneficial effects can a person using ribose supplements expect? Do they include increased energy? Added strength? Increased exercise recovery?

A: There's absolutely no question that ribose supplementation will positively affect heart and muscle cell recovery following high-intensity exercise, and in most cases users will feel more energetic.

The body requires ribose to form adenine nucleotides, such as adenosine triphosphate (ATP). Research has shown, however, that the metabolic pathway leading to ribose production in heart and skeletal muscle isn't efficient, due to a lack of a specific enzyme called glucose-6-phosphate dehydrogenase (G-6-PDH) that regulates the pentose phosphate pathway in cells. In other tissues, such as liver and kidneys, the pathway isn't rate-limited by the enzyme. Consequently, the kid-



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neys and liver can make as much ribose as they need, although that source of ribose isn't available to other organs and tissues. Each cell must maintain its own supply of ribose for nucleotide and RNA production. As energy-producing substrates are used up and lost, they must be replenished. That's where ribose comes in.

Does it add up to increased strength levels? I don't know. It's often suggested, however, that the key to increased muscle strength is increased muscle recovery. Muscles—including the heart—must have the highest amount of energy possible to perform at maximum load. To the extent that ribose improves recovery, it's reasonable to expect that it will help increase strength over time. That's evidenced by the Ball State study discussed above, in which subjects taking ribose were able to perform more work, as measured by higher total, peak and mean power

To the extent that ribose improves recovery, it's reasonable to expect that it will help increase strength over time. Energy is the key to performance, and without question ribose maintains energy in stressed cells.

outputs. Energy is the key to performance, and without question ribose maintains energy in stressed cells.

Q: Are any existing food supplements synergistic with ribose, and, conversely, should some supplements be avoided when people take ribose?

A: The metabolic actions of common food supplements are unique. Creatine, for example, increases energy by providing an increased pool of creatine phosphate to drive the passing of a donated phosphate in the recycling of ADP (adenosine diphosphate) to ATP. Carnitine helps to ferry fatty acids across the mitochondrial membrane, which enhances energy production from fatty acid metabolism. Pyruvate enhances the TCA, or Krebs, cycle that drives the electron transport system in cells, leading to enhanced ATP cycling from ADP. Those nutrients are all unique, but they're all interrelated. They do have one thing in common though: They don't work well without a sufficiently high pool of adenine nucleotides to recycle.

Strenuous, high-intensity exercise decreases the pool of adenine nucleotides in heart and skeletal muscle. That point is beyond debate; it's an established fact. Ribose effectively increases those pools, and as such, it's synergistic with all the compounds that increase the available pool of adenine nucleotides for the above compounds to work with. Thus, while the metabolic mechanisms of the different nutrients are unique, they're also interrelated.

Q: Does ribose also interact with creatine supplements in terms of increasing the effectiveness of creatine in the body?

A: While ribose doesn't directly interact with creatine supplements, it does directly affect the adenine nucleotide pool and so enables creatine to work more effectively. In that sense, ribose does increase the effectiveness of most creatine supplements.

Q: Can people take ribose and creatine at the same time, or should the supplements be used at different times?

A: Ribose is definitely compatible with creatine and can be used at the same time.

Q: Since the average single dose of creatine is five grams, or one teaspoon, what would constitute an average dose of ribose?

A: Ribose is a fairly expensive supplement, due to relatively high production costs, so users may want to experiment with ribose doses. I suggest taking 2.2 grams before and after your workout. That's consistent with the research.

Q: I understand that ribose hasn't been commercially available until now because in the past it was prohibitively expensive to manufacture. Why is the current process more economical?

A: That's a complicated question. There are two basic ways to produce ribose. The expensive technique involves growing yeast cells to high biomass, breaking them apart, collecting the contained nucleic acids (DNA and RNA) and, finally, breaking apart the nucleic acids to collect the ribose. Plenty of steps and expense are involved.

We make ribose by direct fermentation from corn sugar (glucose), a process that's similar to making cheese or other fermented foods. Bacteria in the fermentation eat glucose and produce ribose through their metabolism. We collect, purify and crystallize the ribose. Since the process contains fewer steps, it's less expensive.

Q: What specific adenine nucleotides are lost during intense exercise?

A: An excellent question! The adenine nucleotides include adenosine triphosphate, adenosine diphosphate and adenosine monophosphate (AMP), which collectively supply the vast majority of cellular energy and fuel such activities as muscle contraction. Energy is provided to the cell each time one phosphate group is broken down into another (ATP to ADP to AMP). Under normal conditions, with abundant oxygen available, the recycling of ADP to ATP occurs instantaneously and energy is recycled. When oxygen is depleted, as occurs during high-intensity exercise, though, the recycling process cannot keep up.

When there isn't sufficient oxygen, ADP further degrades. Two molecules of ADP combine to form one molecule of ATP and one molecule of AMP, and the ATP helps the cell perform work. As the process continues, however, the cell suffers an increase in AMP concentration, which it cannot tolerate. Cells need to maintain a careful balance between ATP, ADP and AMP concentrations to maintain normal work and stay healthy. When AMP levels rise, the ratio is pushed out of whack, and the cell must do something to decrease the rising AMP levels.

Skeletal muscles have a few options to correct the imbalance. Notable among them is a process for releasing AMP metabolites from the cell to lower overall AMP concentration; however, that leads to a reduced total adenine nucleotide pool, and it can be a significant reduction. For instance, 50 percent decreases in adenine nucleotide pools have been observed in the heart, and published reports show that the pool can drop 32 percent or more in skeletal muscles. Again, fewer adenine nucleotides mean less ATP, which equals less cellular energy.

Q: Since some rare cases of hypoglycemia, or low blood sugar, can occur with higher doses of ribose, should people who have a tendency to blood sugar fluctuations or diabetes be wary of using ribose?

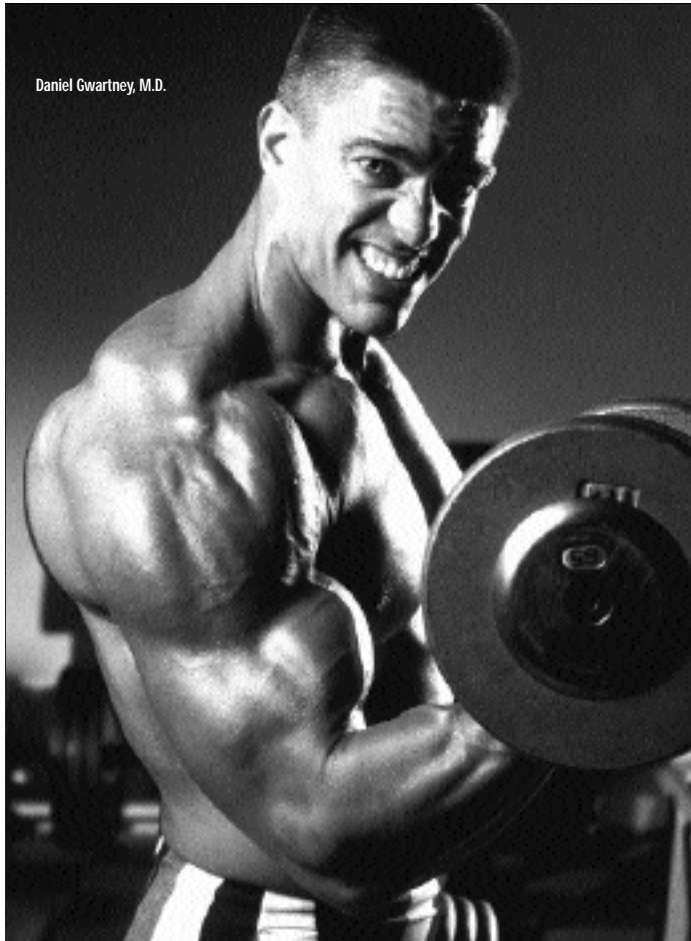
A: High doses of ribose do decrease blood glucose levels. That's the bad news. The good news is that the blood sugar drops aren't usually noticed and are often transient, meaning that they don't last too long. Still, people who have hypoglycemia or diabetes should consult with their physician before using ribose supplements.

Q: Is supplemental ribose just aimed at active people engaged in sports or exercise, or can it also be used to advantage by sedentary people seeking increased energy?

A: The answer is a resounding yes. Anyone who feels he or she needs more energy can take ribose. While we haven't yet conducted specific trials to document that, my company has supplied ribose supplements

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Daniel Gwartney, M.D.

to several people who are sedentary or who exercise lightly. They have generally reported feeling more energetic while taking ribose. While I admit that's entirely anecdotal, it does point to some benefits from ribose for such people.

Q: Is ribose safe for pregnant or lactating women? Is it safe for children?

A: To my knowledge, there's never been a study that specifically looked at the safety of ribose in pregnant or lactating women. Even so, ribose is an all-natural and easily metabolized simple carbohydrate, so there's no reason to suspect that it wouldn't be safe for pregnant or lactating women—or children—if taken in moderate doses.

Q: Are some forms of ribose superior to others?

A: The key to how good ribose is lies with its purity. Several impuri-

ties can be found in ribose. Virtually all of them are other sugars, such as glucose or arabinose, or sugar alcohols such as sorbitol. The impurities may be hard to find with standard analytical techniques because they're hidden by the ribose. By and large, such impurities aren't toxic, but they also aren't ribose.

Bioenergy supplies highly purified ribose manufactured in the United States. Our plant operates under good manufacturing practices (GMP) as defined by the Food and Drug Administration for food production and is available for inspection at any time. Final purification of our product is done at a plant that also makes pharmaceuticals. Such plants must provide the highest purity possible. Other suppliers of ribose import their products from overseas, and those products may come from plants that don't meet GMPs and aren't available for ready inspection. Purity does matter.

Q: Do you anticipate that ribose will be an expensive supplement in comparison to creatine supplements?

A: Unfortunately, I do. The manufacturing process for ribose is much more complicated than that of creatine, which will keep the price higher. As production volume and efficiency increase, however, the possibility exists that ribose prices will become more moderate.

Q: Will ribose work better for a world-class athlete than it will for the average gym jockey?

A: That's a tough question, as there are lots of factors at play. World-class athletes are different from the rest of us. They're often genetically gifted and through years of training have conditioned their muscles to react more efficiently and effectively. Being human, though, they still lose adenine nucleotides after intense athletic or exercise activity.

Anyone who exercises at high intensity will lose those nucleotides and will benefit from using ribose supplements. The degree to which people lose nucleotides and the speed of recovery may vary, but all will benefit. In that respect I don't expect a world-class athlete to react more favorably to ribose than the average gym jockey, assuming that the gym jockey works out to his or her fullest capacity.

Q: How can ribose be used to treat various medical conditions?

A: My company is currently conducting clinical research involving the use of ribose in treating ischemic heart conditions. A large volume of other research from labs in the U.S., Europe and Japan has been conducted over the past several decades and has shown considerable efficacy for ribose in the treatment of energy-deficient hearts.

Ribose is also useful in treating other medical conditions. Any pathology involving a deficiency of ribose-producing enzymes may be improved with supplemental ribose.

Q: Do you anticipate ribose supplements eventually becoming as popular as or even more popular than creatine supplements?

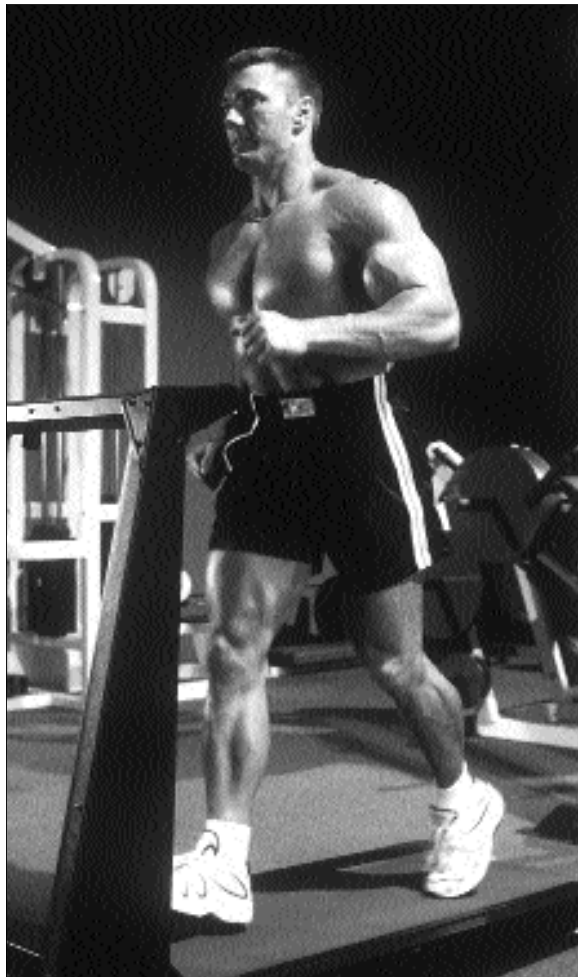
A: I must say that I really do. While ribose is more expensive than creatine, it's an incredibly effective nutrient for energy recovery. Only ribose can maintain the body's adenine nucleotide pools, which are the

Anyone who exercises at high intensity will lose those nucleotides and will benefit from using ribose supplements. The degree to which people lose nucleotides and the speed of recovery may vary, but all will benefit.

Only ribose can maintain the body's adenine nucleotide pools, which are the cornerstone of all energy production.

The biochemistry and physiology behind ribose use are beyond question.

Ribose works, period.



cornerstone of all energy production. Certainly, we need further research, as there are still several unanswered questions. Nevertheless, the biochemistry and physiology behind ribose use are beyond question. Ribose works, period, and has broad application for athletes and anyone interested in maintaining good cardiovascular health.

Anavolics: The Science Behind Cell Volumization

by Daniel Gwartney, M.D.

Anavolics is a term I coined that's derived from two words, *anabolic* and *volume*. Perhaps it makes some sense that as a tissue, specifically muscle, grows (anabolic), it will take up more space (volume). As a review of the published studies indicates, however, that may be putting the cart before the horse. It appears that an increase in volume occurs first, and the anabolic process follows.

Very few supplements are anabolic. Frankly, the only ones that have shown any mass-building properties are creatine, certain amino acids (in various concentrations), high-protein formulas and insulin-based high-glycemic formulas. Some products used in animal feed are promoted as anabolic but aren't effective as performance supplements. The fact is, nothing currently available is as effective as anabolic steroids. Creatine is close for the first-time user, being comparable in effect to a light cycle of an oral steroid like Anavar. That's not surprising, as many of the oral steroids cause an increase in hepatic, or liver, production of creatine.

Most of the other supplements that have an effect are used to increase energy production or availability or act as stimulants. A select few have been shown to modify the catabolic response, decreasing muscle breakdown during exercise or fasting.

The bottom line is that most lifters and many athletes want to find a natural, nonbanned supplement that has an anabolic effect. Despite what many of the recreational, fad-oriented fitness gurus say, we all want more muscle. At every bodybuilding show I attend or judge, I hear statements like, "Next year I'm going to come in 10 pounds heavier," or, "If I could just pack on some more size." Even the three-times-a-week, color-coordinated, minivan-driving lifter is looking for an extra inch or two of arm mass—just some indication that all the work isn't being wasted. Gyms lose roughly half of their clients every year. Many quit because they see no progress; others because they're lazy. If people see progress, they get excited and stay involved.

That's the real purpose of all the dietary supplements—to support effort and allow people to see

That's the real purpose of all the dietary supplements—to support effort and allow people to see results. I don't think any of us expect a miracle. The new product AnaVol-R™ is designed to support effort and facilitate growth. Its formula is based on data and conclusions from scientific studies, hypotheses drawn from other sources and some ideas that come from experience and observation.

Is there any evidence that the idea of increasing cell volume to create an anabolic response is based in reality? The answer is yes. Cell volume increase occurs prior to the biochemical events related to protein or glycogen synthesis.

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The new product AnaVol-R™ is designed to support effort and facilitate growth. Its formula is based on data and conclusions from scientific studies, hypotheses drawn from other sources and some ideas that come from experience and observation. As consumers respond and give us feedback on this compound, each generation may be modified to include the best and newest information.

Is there any evidence that the idea of increasing cell volume to create an anabolic response is based in reality? The answer is an emphatic yes. Cell volume increase is a common, meaning shared, event seen in cells that are exposed to hormones or nutrients that cause an anabolic response. In fact, the cell volume increase occurs prior to the biochemical events related to protein or glycogen synthesis. A German researcher by the name of Haussinger has published a large number of studies investigating the role cell volume changes play in cellular metabolism. I'm not implying that he supports, endorses or is even aware of this product. I mention him only so readers who wish to do their own review will have a starting point.

If volume changes are actually responsible for the metabolism of a cell, why haven't others written about it in the many fine (and less-than-fine) strength magazines? Frankly, the material isn't easy to find. The easy stuff is already exploited to nearly unrecognizable states. Ephedrine, creatine, protein and caffeine have all been included in many products because the information base is easily accessed and widely distributed; however, there's a huge amount of scientific material that is not available on databases like Medline. Much of it is what's called basic research, meaning that it's been performed in a test tube, cell plate or tissue culture or on animal models. Basic science represents the frontier of science, as it challenges researchers to prove or disprove something that's as yet unknown. Once it's proven, then it can be applied, meaning that it's put to use. Studies in applied science validate questions that have been raised and investigated in basic science.

Cell volume increases signal anabolic functions. That was demonstrated when researchers exposed cells to anabolic hormones and measured the cellular response. In an identical set of cells they induced an increase in volume by changing the osmolarity, or salt content, of the solution surrounding the cell. The cells that were exposed to anabolic hormones swelled, much like a sponge when exposed to water. Surprisingly, the researchers noted the same cellular response in the second set of cells, even though no anabolic hormone was used. Later studies showed that shrinking the cells caused an opposite effect—the same effect that occurred when cells were exposed to catabolic hormones! So let's make this first and critical point clear:

Cell volume increase (swelling) creates an anabolic response.

Cell volume decrease (shrinking) creates a catabolic response.

Imagine living in a small one-bedroom apartment. You fill it up with furniture, stopping when the rooms are full. Life is wonderful, and soon you're able to afford a two-bedroom house with a basement. What do you need or want as soon as you move? More stuff to fill the rooms. Soon you have an office set (instead of a card table), a washer and dryer, a coffee table and a serious entertainment center. Your space (volume) gets bigger, so you get more stuff. Later, life bites and you return to the one-bedroom apartment. Many of the things disappear—either to Dad's basement or to the repo man. Your space (volume) gets smaller,



A German researcher by the name of Haussinger has published a large number of studies investigating the role cell volume changes play in cellular metabolism.

There are a number of different cellular solutes that can enter a cell and cause it to swell. They typically pull water into the cell, causing a volume increase.

and you lose stuff. Think of your muscle cells as the living space and your possessions as muscle cell protein and cell contents. Bigger place, more stuff; bigger cell, anabolic growth.

The application to bodybuilding is obvious. Let's swell those muscle cells until they explode. Can they explode? That might be cool to watch, but it sounds painful and may affect your bench press. Actually, the cells can't explode and in fact can only have a moderate degree of swelling. There are regulatory mechanisms in place to prevent the occurrence of unlimited swelling. When a cell dies, however, the mechanisms are gone, and it may shrivel into a dead shell.

So, as exciting as unlimited growth would be, the best we can get is slow progressive growth after repeated exposure to agents that cause cellular swelling. That brings us to supplements.

There are a number of cellular solutes that can enter a cell and make it swell. They typically pull water into the cell, causing a volume increase. What's more, some of the agents will have hormonal responses in addition to the cell volume effect.

The following are the ingredients in AnaVol-R™. I have included a few references just to prove that it's all not just flying out of my lower sphincter, as has been known to happen in this industry.

•**Creatine monohydrate, five grams.** When creatine was first introduced into the market, one of the main effects touted was cell volumizing. That point was quickly dropped because nobody knew how to make it a selling point, and the supposed effects of creatine were so easily felt that it didn't matter whether there was any real science behind it. Recently, a study by Ziegenfuss, Lowery and Lemon was published online in the *Journal of Exercise Physiology* (October 1998) that showed a 3 percent increase in water inside the cell after a three-day loading routine. That's consistent with the results most of us see with creatine loading: a gain of about 2 to 3 percent of bodyweight during loading (four to six pounds for a 200-pound person). Remember, the purpose of AnaVol-R is not only to provide a performance-enhancement effect but also to induce an increase in cell volume. What about creatine solubility? AnaVol-R is titrated, or balanced, at a pH of approximately 4.5. That's the pH at which creatine is soluble, just as occurs in the effervescent formulas. Five grams of creatine, delivered at a pH of 4.5, should be absorbed well and tolerated well.

•**D-ribose, two grams.** D-ribose (the R in AnaVol-R) is a newcomer to sports nutrition. That's not because we didn't know about it but because it couldn't be manufactured cost-effectively until recently. Numerous studies are looking at the use of D-ribose for low-cellular-energy states in disease and ischemic conditions. They've all shown a positive effect of D-ribose supplementation on adenosine triphosphate (ATP) and total adenine nucleotides (TAN). The benefit of adding D-ribose to AnaVol-R is twofold. First, by maintaining cellular ATP, it ensures that cellular energetics are favorable toward the anabolic processes. Second, if the high turnover in ATP required by exercising muscle affects cellular

ATP, it may also affect other nucleotides. What does that mean exactly? We've all heard of DNA and RNA. The acronyms stand for deoxyribonucleic acid and ribonucleic acid. If you look carefully, you'll see the prefix *ribo-*. *Ribo-* as in ribose, or D-ribose. DNA and RNA are the genetic molecules that determine the structure and function of all human cells. If we are robbing the cell energy nucleotide pool, we may be affecting the nuclear, or genetic, nucleotide pool, which is not a good thing. D-ribose, at the very least, will support the formation of new ATP and repair or salvage existing ATP (Brault, J.J., and Terjung, R.L., 1999). Possibly, it may aid in promoting the cell's ability to respond to stimuli such as training or volume changes (Bernofsky, 1980; Coffey, et al., 1965; Hellsten-Westling, et al., 1993). What's more, D-ribose also aids in the insulin response of AnaVol-R (Goodman, C., and Goetz, F.C., 1970; Malaisse, W., and Malaisse-Lagae, F., 1969).

•**Pinitol, 50 milligrams.** Here's something completely new. Pinitol is a methylated sugar (3-O-methyl-1,2,4 cis-3,5,6 trans hexahydroxycyclohexanol) that has two effects of significant value: increased glucose uptake by the muscle cell and increased glycogen synthesis. Pinitol is an isomer, or type, of inositol. It's extracted from soy and sugar pine heartwood. It was first discovered to have hypoglycemic effects—that is, it lowers blood sugar—in 1987 (Narayanan, C., 1987) and later found to enhance insulin function as well.

Pinitol was first discovered in the methanol fraction of *Bougainvillea spectabilis*, a botanical used in traditional healing for many purposes, including diabetic-associated conditions. It was later found to be a component of pH 2.0 D-chiro-inositol glycan insulin putative mediator (Fonteles, M.C., et al., 1996). Infusion of pinitol leads to an insulinlike action without causing hypoglycemia. Therapeutically, that's very important, as it demonstrates some means of regulatory control to prevent the negative consequences of hypoglycemia. To the athlete it means not getting sluggish, drained and losing it. It's not yet clear how that happens, but it may be due to selective action at the muscle to increase glycogen synthesis.

Ongoing research at St. Johns University has demonstrated both glucose uptake and glycogen synthesis in muscle tissue culture, and further research that should clarify pinitol's role in cell volume and cell metabolism is under way. It's definitely one product we'll be hearing more about in the future.

Of all the proposed so-called insulin mimickers and insulin co-factors, pinitol is the one with the most promise. Insulin hits a receptor and then is done. It's a big protein, so you can't see it passing through the cell membrane. Rather, it acts through secondary messengers, or insulin mediators. One of the first mediators is a pseudo-disaccharide of pinitol and galactosamine chelated to manganese, which may activate rate-limiting enzymes for both oxidative (used for energy) and nonoxidative (stored as glycogen) glucose metabolism. Research has shown that levels of the mediator are reduced by 50 percent in the muscles and urine

If we're robbing the cell energy nucleotide pool, we may be affecting the nuclear, or genetic, nucleotide pool—which is not a good thing. D-ribose at the very least, will support the formation of new ATP and repair or salvage existing ATP used during exercise.

Pinitol is a methylated sugar that has two effects of significant value: increased glucose uptake by the muscle cell and increased glycogen synthesis. Of all the proposed so-called insulin mimickers and insulin co-factors, it's the one with the most promise.

of type II diabetics (Asplin, L., et al., 1993). There are some other exciting properties of pinitol, but I'm not at liberty to disclose them at this time. Trust me. There will be knockoff products using pinitol in no time. Just remember where you heard it first, folks.

•**Maltose-and-dextrose blend, 24 grams.** Dextrose is a sugar found in nearly every powder, bar and candy, and like other sugars it has four calories per gram. It's used in creatine delivery to prompt an insulin spike. Using a lot of it will give a greater insulin spike, but it will also give you a big tummy. If you want to look eight months pregnant, go for the high-dextrose-content formulas. What's more, if you take a large amount of sugar at once, the sugar will go to your liver for storage rather than the muscle (Charrington, A., Vanderbilt University Medical Center). It has to do with the amount of sugar in the portal blood, the blood that delivers nutrients from the intestines to the liver, compared to what's in the peripheral bloodstream, the circulating blood supply to the body. Too much sugar, and it doesn't do the job. I wouldn't recommend driving heavy equipment after you take a high-dextrose-formula supplement either.

Maltose is a type of sugar, a disaccharide, that has a higher glycemic index than dextrose and is well tolerated. It's not so potent a signal for insulin release that it will trigger hypoglycemia, but it will aid in promoting the insulin signal without adding a large number of carbs. Consequently, the sugar blend is designed to promote an adequate insulin response to enhance the cell volume effect of the nutrients without making you fat. A maltose-and-dextrose blend of 24 grams, added to the two grams of D-ribose, provides 26 grams of sugar, stimulating insulin release.

•**Chromium GTF, 100 micrograms.** Chromium doesn't do much and is really too weak to be considered as a single-ingredient product. Whenever insulin function is a factor in product action, however, there's a place for chromium. Chromium picolinate has received all of the attention in the supplement market, and it's given in doses as high as 500 micrograms (that's micrograms, not milligrams). High doses may have potential for adverse long-term effects. Picolinate may be fine, or it may be linked to negative cellular events. I'm not certain that it's entirely safe and don't feel it's worth the risk.

Chromium GTF acts as a co-factor to insulin. That means the insulin is actually doing the work, but the chromium GTF performs a function or functions that allow insulin to do its job better. It's like having a great chef in a restaurant. He'll prepare a fantastic meal, but if there aren't enough waiters, the food will arrive cold and won't please you as it should. The chef (insulin) is doing the work, but he needs a co-worker (chromium GTF) to enable him to do his best.

•**Proprietary blend of amino acids, dipeptides and tripeptides.** Muscle cells, like all cells, have class-specific amino acid carriers. By class, I mean that certain types of amino acids use one carrier, while other types use another. That's true for the intestinal membrane as well.

It's based on such factors as size, charge and side chains. Amino acids are limited by the number of transporters present on the intestinal membrane as to how much may be absorbed; however, one method of getting around that limitation is to provide not only free-form amino acids but dipeptides and tripeptides as well.

Dipeptides and tripeptides are carried across the intestinal membrane by separate carriers, which allows a greater concentration of amino acids to reach the bloodstream. It doesn't take a great concentration of certain amino acids to cause a muscle cell to swell—and swelling equals anabolic growth.

There's a small number of amino acid transporter classes on the muscle cell. There's also a small number of amino acids that have been shown to have a cell-volume-increasing effect on muscle cells. So, by using the specific amino acids to react with the specific transporters, you should be able to get a volumizing effect. You won't be changing wardrobes overnight, but remember that you're after the long-term effect of increased cell volume. The good news is that the volumizing effect of the amino acids is enhanced in the presence of insulin. Now you can see why the pinitol, sugars and chromium GTF play such vital roles in the formula.

In a nutshell, then, AnaVol-R is a formula designed to promote cell volume increases to support an anabolic phase of metabolism. It has the potential to trigger growth. It's not a 300-calorie creatine-and-carb blend that will plump you up like a Thanksgiving turkey, and it's not a hormone. It's based on the way the body reacts to the signals that lead you to grow. It's designed to allow—even force—your body to grow.

AnaVol-R is designed to draw fluid into the muscle in order to generate an anabolic response. The following recommendations involve a little intelligence and some common sense. I haven't determined whether or not loading would be beneficial.

•Take one serving of AnaVol-R in one liter of water immediately upon awakening. That's a lot of water, but after sleeping for eight hours, your body needs it anyhow.

•Wait at least 45 minutes before eating, which will allow the AnaVol-R to be absorbed without the interference of a meal.

•Eat at least 40 grams of protein with your first meal to provide amino acids for the volume-mediated anabolic response.

•Continue to drink sufficient fluids throughout the day to avoid dehydration, which may lead to fluid and volume loss from the cells. Studies have shown that hyperhydration increases the loss of total bodyfat stores.

•Eat every three hours, if possible, monitoring calories to meet your physique and performance goals, and include at least 25 grams of protein with each meal.

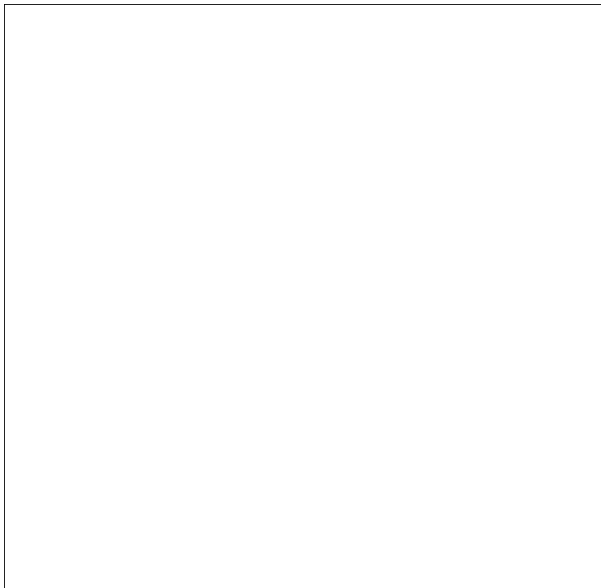
•If you want, have another serving of AnaVol-R before going to sleep; however, keep in mind that you'll be getting up to urinate if you

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In a nutshell,
then,
AnaVol-R™ is
a formula
designed to
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volume
increases to
support an
anabolic
phase of
metabolism.
Its potential is
for growth,
plain and
simple.

do.
AnaVol-R is a first-generation product that will evolve into a giant maker. In fact, I believe the current formula is already a giant maker. There's only one way to find out: Try it.

Editor's note: AnaVol-R™ was developed by Ergogenix, LLC, a private research and development company working in the specialty nutrition industry.





***Growth Hormone
Boosters: Build
Muscle and
Burn Fat***

4



GH: Blast Yours to New Levels

by Jerry Brainum

In this new age of natural bodybuilding many bodybuilders are putting their faith in growth hormone for druglike size-and-strength increases. This powerful hormone has proved itself as an anabolic agent by triggering enhanced muscle protein synthesis or reduced muscle protein catabolism. In other words, it can give your sluggish hypertrophy a high-voltage charge.

Athletes from all sports have been putting it to the test for years. For example, recently, several members of the Chinese swim team were caught with growth hormone in their possession while on their way to an international meet in Australia. GH is popular with athletes because, though it's officially banned by most international athletic governing bodies, it's presently undetectable by drug tests.

Rumors are rampant that GH is also a popular bodybuilding drug. Most top-level bodybuilders who've used it say that when taken alone, it helps preserve muscle during stringent dieting and speeds up fat loss. When combined with other anabolic substances, such as anabolic steroids (particularly testosterone injections) and insulin, GH has synergistic anabolic effects. Some bodybuilding observers even speculate that this combination of drugs explains the current spate of bodybuilding behemoths, with a few competitors walking on stage weighing 250 or more minus even a scintilla of apparent bodyfat.

While it seems as if the use of drugs such as GH is rampant in bodybuilding, the truth is that availability is often limited by cost. It's expensive to take the correct amount of GH, and if you take it for too long, the chances of side effects increase. Possible side effects include gynecomastia (male breasts); carpal tunnel syndrome (a painful nerve impingement of the hand that often requires surgery); and a facial disfigurement called prognathism, which is characterized by a protruding jaw and forehead that create an apelike appearance.

Recognition of these problems has led many athletes to investigate safer, more natural means of promoting GH release. Several amino acids are

known to elicit a GH response, the most prominent being arginine and ornithine. One problem with that strategy is that the most reliable release of GH with amino acids occurs when the aminos are given intravenously, often in 30-gram or higher dosages.

An often-quoted 1981 Italian study of 15 healthy young men showed that providing them with only 1,200 milligrams each of arginine and another amino acid, lysine, led to GH blood levels eight times higher than baseline. Large doses of oral amino acids, however, may cause gastrointestinal distress because of a pronounced osmotic effect. In effect, they draw water into the intestine, leading to symptoms that can include gas, bloating and diarrhea. Even if you escape that uncomfortable fate, the aminos may be degraded by liver enzymes before reaching the blood.

Using various amino acids for eliciting GH release also depends on several other extenuating factors. For example, GH is released more reliably under conditions of low blood glucose and a low content of circulating free fatty acids in the blood. That means such aminos work best if taken on an empty stomach, which explains the frequent suggestion to take GH-promoting aminos before bedtime—assuming you haven't eaten anything for at least three to four hours. Taking them at bedtime is a way to augment the natural peak release of GH, which occurs during the initial 90 minutes of sleep.

Taking other amino acids in conjunction with GH releasers, such as a whole-protein supplement like whey, will completely negate any GH activity of the GH-releasing aminos due to competitive interference with brain uptake by other circulating amino acids.

Still another limiting factor that determines the efficacy of GH-releasing amino acids is acetylcholine production in the brain. Acetylcholine is a brain neurotransmitter synthesized from acetyl coenzyme-A and the nutrient choline. The significance of acetylcholine with regard to amino acid GH releasers is that the release of GH through

These peptides are available orally, unlike GH or IGF-1, which must be administered by injection. The general term for them is growth hormone secretagogues, since they work by augmenting both the amount and release of existing GH in the brain's pituitary gland.

amino acids is fostered by acetylcholine activity in the brain's pituitary gland. Thus, if your acetylcholine production isn't up to par, you'll get no benefits from any quantity of GH-releasing supplements.

The philosophy behind Symbiotropin is to take commonly available natural GH releasers to a higher, more effective level that compensates for the many problems associated with using oral amino acids for that purpose. Symbiotropin is based on the discovery in 1981 of peptides that are similar in structure to naturally occurring pain substances such as enkaphalin in the human brain. Enkaphalin acts like a natural form of morphine in lessening pain perception, and for some unknown reason it also boosts GH release.

The usual release of GH in the brain depends on the interplay between a substance that promotes GH release (growth-hormone-releasing hormone, or GHRH) and one that inhibits it (somatostatin). The interesting thing about GH-releasing peptides is that they act independently of both of the usual GH-limiting substances. The peptides themselves are just a chain of six or so amino acids in a specific sequence.

Several of those GH-releasing peptides have been, and still are, under continuous study. They're of extreme interest to researchers because they appear to increase the active anabolic factor of GH, insulinlike growth factor 1 (IGF-1). As such they have potential benefit in treating many catabolic diseases, such as those associated with HIV, cancer and aging. The advantage of these peptides is that they're available orally, unlike GH or IGF-1, which must be administered by injection. The general term for them is *growth hormone secretagogues*, since they work by augmenting both the amount and release of existing GH in the brain's pituitary gland.

The potency of a few of the synthetic secretagogues is impressive. For instance, in one study a GH peptide called MK-677 was given to 15 elderly women and 17 elderly men. Taking the drug orally for four weeks enhanced pulsatile GH release and restored IGF-1 levels to those found in young adults.

So what happens if you give an oral GH peptide to a younger person? In a 1996 study of young men, MK-677 given orally for one week resulted in an enhanced GH pulse activity without an elevation of GH secretion. IGF-1 levels also increased, as did the stages of deep sleep. That's significant and exciting for bodybuilders because most of the body recovery attributed to sleep takes place during those deep-sleep stages.

Based on the findings of studies involving drug versions of oral GH secretagogues, a pharmacologist decided to develop a natural form, which he called Symbiotropin. In the bodybuilding world it's known as GH Stak. The primary ingredient in Symbiotropin is pituitary peptides, similar in structure to the drug versions; however, the supplement contains other ingredients as well, including what the developer calls chaperon molecules, which enhance its effectiveness and delivery.

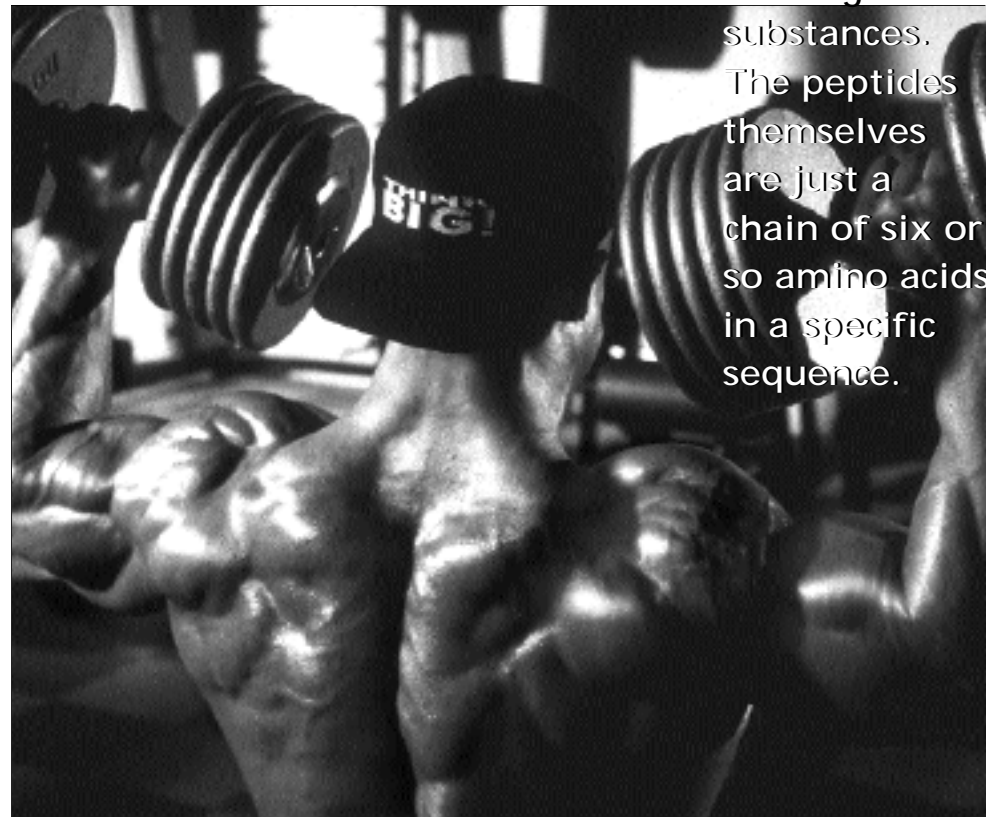
Symbiotropin also contains several known GH-releasing amino

acids, such as arginine, glutamine, GABA, glycine, lysine and tyrosine. It's a very powerful combination. The developer says that because of the superior delivery system incorporated into Symbiotropin—i.e., the chaperon molecules—the amino acids contained in the product are far more efficient in promoting GH release than if you took the same aminos independently.

The brain chemical L-dopa is also a known GH releaser. L-dopa is made in the body from the amino acid L-tyrosine and is used medically to treat Parkinson's disease. Symbiotropin contains a legume called the Lacuna bean that's found in the rain forest and is naturally high in L-dopa. While the developer of Symbiotropin indicates that the bean is one of the primary ingredients, the amount of the L-dopa that gets past the protective blood-brain barrier is open to question. I imagine the so-called chaperon molecules are involved in that activity.

As with GH-releasing aminos, Symbiotropin is best taken on an empty stomach, either right before bed at night or in the morning as soon as you get up. The latter technique may be best, since studies done with the drug versions of GH peptides show that you get a more reliable GH release if you take the drugs first thing in the morning on an empty

The interesting thing about GH-releasing peptides is that they act independently of both of the usual GH-limiting substances. The peptides themselves are just a chain of six or so amino acids in a specific sequence.



Symbiotropin, or GH Stak, has demonstrated its ability to significantly boost anabolism and recovery, which makes it a boon to many drug-free bodybuilders looking for that all-natural increase in mass and strength.

stomach. To facilitate uptake, Symbiotropin is provided in an effervescent tablet that you dissolve in water because, as the developer notes, studies show a 15 percent increase in GH release from oral glutamine when the amino is provided in an effervescent form.

You're also advised to exercise within an hour of taking Symbiotropin, again on an empty stomach. That gives you a synergistic effect between the known GH-releasing effects of exercise and the GH enhancement induced by Symbiotropin. Training with a high level of intensity, focusing on working larger muscle areas, also adds to the effect.

The suggested dosage schedule for Symbiotropin is to take it for five consecutive days, followed by a two-day break and then repeat the cycle. While Symbiotropin is generally suggested for people over 40 who show a decline in IGF-1 levels (80 percent of people over 40), in an unpublished study of Symbiotropin that included both elderly people and three young, healthy bodybuilders, one bodybuilder had an 8.5 percent increase in measured IGF-1 levels after just one day of using the supplement. Another bodybuilder in the study had a 12.5 percent rise in IGF-1 after a day, while the third showed a 36.6 percent increase after six days of taking Symbiotropin.

That contrasts with the results for the older people in the study, who started with low levels of IGF-1. Their levels increased anywhere from 7 to 229 percent after they used Symbiotropin for varying time periods. Obviously, the lower your baseline IGF-1 level, the higher it will be after you take something known to increase it. IGF-1 levels are measured based on the ephemeral blood levels of GH. While GH is broken down in the liver about an hour after being released into the blood, IGF-1 levels—which are directly stimulated by GH—last for up to 18 hours.

Also noteworthy is the fact that one clinic in California that dispenses GH as a means of youth restoration offers Symbiotropin as an alternative for needle-shy patients. According to the professionals at that clinic, the results seen with Symbiotropin show that it's about 65 percent as effective as actual growth hormone injections. In fact, many doctors are using Symbiotropin exclusively.

From all indications the next level of muscle-building supplementation has arrived. Symbiotropin has demonstrated its ability to significantly boost anabolism and recovery, which makes it a boon to many drug-free bodybuilders looking for that all-natural increase in mass and strength.

Natural GH Surge

Interview by Jerry Brainum

Growth hormone has long intrigued bodybuilders and other athletes. The perception is that it will promote muscular size while fostering a loss of bodyfat—a holy grail combination for physical enhancement and athletic performance. Other desirable aspects of growth hormone include its much publicized anti-aging benefits and various possible health-enhancing properties associated with maintaining optimal levels of it.

The two most common approaches to modulating growth hormone in the body have involved either pharmaceutical or natural methods. The pharmaceutical approach consists of synthetic growth hormone injections and the still experimental oral secretagogue drugs. Injections do work but are expensive for long-term usage. They may also have side effects, depending on the dosages and the length of time the drug is used.

The natural approaches, while safer and cheaper, have not generally proved as effective. Natural methods of increasing the body's GH output include taking various amino acids, such as arginine, ornithine and glutamine, as well as various amino acid by-products, such as GABA and its analog, GHB.

Why don't the safer, natural versions of GH stimulators work? A primary problem is getting the required nutrients to the active areas of GH secretion; i.e., the brain. The body has a number of built-in barriers to prevent the entry of substances into the brain. For example, large doses of amino acids—such as those required to effectively elicit a GH response—are often degraded by liver enzymes.

That such natural substances can stimulate an effective GH response is proven when the same substances are allowed to bypass barriers, as in intravenous administration. Providing 30 grams of the amino acid arginine intravenously is so effective at inducing GH secretion from the pituitary gland that it was formerly used as a provocative test for pituitary GH release.

Drug companies have developed drugs called

GH secretagogues based on the discovery that small amino acid linkages called peptides can elicit a significant GH release. Most of the drugs are still considered experimental, but the exciting aspect is that they're effective orally.

A natural product called GH Stak is also a potent GH secretagogue, according to its developers. Since growth hormone itself is degraded within an hour after reaching the blood, the level of a primary GH product, insulinlike growth factor 1 (IGF-1)—which circulates in the body far longer thanks to protective binding proteins—is considered an accurate measure of GH output. From a bodybuilding perspective, that's important because IGF-1 is also considered the active anabolic component of growth hormone. Preliminary studies show that GH Stak increases IGF-1 in various populations.

To find out more about the possible benefits of using GH Stak, I interviewed Lawrence E. Dorman, M.D., who has practiced osteopathic medicine for more than 30 years in Independence, Missouri. Dorman specializes in nutritional and preventive medicine and has worked with several professional athletic teams. He has also researched the supplement and administered it to his patients and has a thorough knowledge of its potential benefits.

Q: A recent widely publicized study implicated high levels of IGF-1 as a promoter of prostate cancer. Does IGF-1 promote cancer?

LD: That study was extremely flawed. If high levels of IGF-1 actually promoted cancer, then people would have to stop exercising immediately because exercise is a potent IGF-1 stimulus. Other physicians and I have examined this purported IGF-1/cancer connection, and we've all agreed that the study was likely funded by pharmaceutical companies that had their own agendas.

In reality, the opposite is true. Since most types of cancer result from a failure of the immune system to curtail incipient tumors, IGF-1, as a potent immunostimulant, would serve to have a preventive effect against cancer.

By stimulating the immune system, higher IGF-1 levels protect the body against the onslaughts of various stresses and associated diseases.



Q: How would maintaining higher IGF-1 levels help to prevent diseases?

LD: Maintaining an optimal IGF-1 level throughout life would help prevent virtually any type of disease. A primary reason that older people show higher rates of various degenerative diseases is that the body gradually loses the ability to ward off such diseases. This loss is related to a lifetime of poor health habits, such as lack of exercise, obesity, lack of sufficient nutrients and chronic exposure to environmental toxins, as well as unbridled stress.

By stimulating the immune system, higher IGF-1 levels protect the body against the onslaughts of various stresses and associated diseases. When you examine chronically ill people, you always find below-normal IGF-1 levels. A study published in a major journal found that patients who had suffered heart attacks showed the highest death rates if they also had low IGF-1 levels.

Q: Assuming that GH Stak is effective in increasing IGF-1 levels, do you expect a market flooded with imitation products?

LD: [GH Stak] isn't easily duplicated for at least two reasons. The first is that duplication of the product requires an extensive knowledge of anterior-pituitary peptides. Only a few chemists in the world know how to produce those special peptides.

The second reason involves the delivery of the special peptides to target areas. Anyone attempting to duplicate [GH Stak] would have to devise a way to successfully transport them across such hostile environments as the acidic gastric mucosa and get them into the blood without being destroyed. This process requires special "chaperon" molecules, for which the chemistry is extremely obscure.

I expect that many companies will claim to have an equally effective knockoff version of [GH Stak], but they won't work as well. We've already tested a few products, and they didn't live up to hype.

Q: Obese people are often insulin-resistant and also show blunted growth-hormone-releasing patterns. Would using GH Stak have any benefits for such people?

LD: If you administer GH injections, the drug will initially produce insulin resistance and subsequent glucose intolerance. However, the opposite is true with a growth hormone secretagogue such as [GH Stak]. We've found the product is so effective at increasing insulin sensitivity that elevated blood glucose levels rapidly decline. When we give it to insulin-dependent diabetics, we always warn them to closely monitor their blood glucose levels. We've taken a few diabetics off insulin therapy

when they began using [GH Stak] because of improved glucose control.

Q: Since a high blood glucose level is known to blunt GH release, would a lower-carbohydrate intake while using GH Stak offer any advantages?

LD: You do want to limit carbohydrate intake a few hours before using [GH Stak] to elicit a maximal effect from it. You should also not consume any protein foods for at least three to four hours before using [GH Stak]. Amino acids will compete with some of the components found in the supplement for uptake into the body.

Q: What's the best way to use GH Stak?

LD: I'd recommend waiting at least an hour to eat anything after using it. It's not advisable to combine [GH Stak] with food or supplements that would decrease the effectiveness of the product. That includes any type of protein or creatine supplement.

Q: Do you suggest consuming more protein while using GH Stak?

LD: Most active people already consume high-protein diets, and using [GH Stak] with such diets produces a synergistic effect. On the other hand, I think that even active people shouldn't ingest too much protein and they should consider mixing protein sources. That would involve consuming both animal and plant-derived proteins.

Q: Is there any type of dietary fat that people should emphasize while using GH Stak?

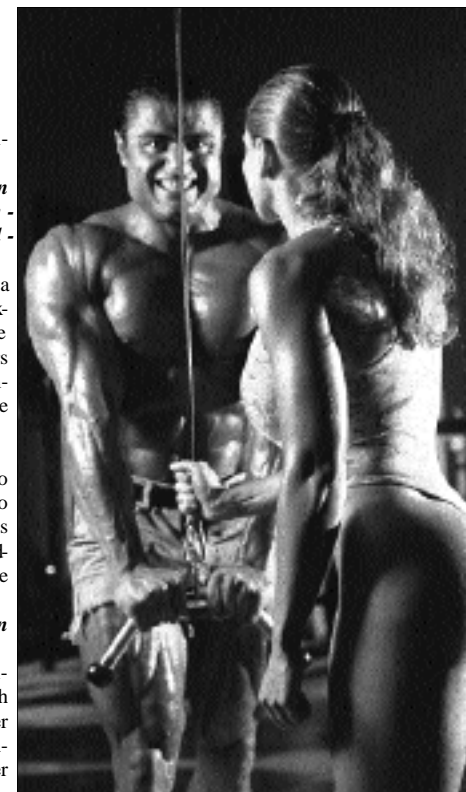
LD: Monounsaturated fat, such as that contained in olive and canola oils, is a good type of fat to eat. It's less subject to oxidation and helps to maintain higher levels of protective high-density-lipoprotein cholesterol in the body.

Q: Should the focus be on lower-glycemic-index carbohydrates, which promote less insulin release?

LD: The type of carbohydrate is more of an issue with people who are just beginning to exercise. Regular exercise promotes more efficient usage of ingested carbohydrates, such as a greater glycogen storage capacity. Thus, most people have an enhanced carbohydrate uptake after exercise.

Q: What about using supplements that increase insulin effectiveness, such as chromium or vanadyl sulfate. Would they enhance GH Stak's effects?

LD: Those supplements are fine; however, vanadyl is toxic to the kidneys after long-term use. I'd suggest using a safer vanadyl complex



Most active people already consume high-protein diets, and using [GH Stak] with such diets produces a synergistic effect.

Androgen precursors are converted by liver enzymes into testosterone, while [GH Stak] promotes peripheral IGF-1 synthesis and release, as in muscle. One touted androgen precursor, however, does increase IGF-1, and that's DHEA.

instead. Several of them are available.

Q: What's the purpose of the special legume contained in GH Stak?

LD: The legume used is a product of the rain forest. It contains an amino acid by-product called L-dopa that's a recognized GH releaser in the brain. Normally, the L-dopa would be destroyed in the gut before it got to the brain, but the chaperon molecules in GH Stak can successfully shield it from being prematurely degraded.

Q: Why is the effervescence factor contained in GH Stak so important to the product's effectiveness?

LD: The effervescence promotes rapid assimilation of the factors contained in [GH Stak]. Those active factors, such as the anterior pituitary peptides, are fragile, and the longer they're exposed to hostile environments such as stomach acidity, the greater the risk of degradation. The effervescence helps to neutralize some of the potentially hostile exposures.

Q: Are there interactions between GH Stak and any of the popular testosterone precursors now on the market?

LD: Androgen precursors, such as androstenedione, take totally different biochemical pathways than does [GH Stak]. Androgen precursors are converted by liver enzymes into testosterone, while [GH Stak] promotes peripheral IGF-1 synthesis and release, as in muscle. One touted androgen precursor, however, does increase IGF-1, and that's DHEA.

Q: What results can a bodybuilder expect after beginning to use GH Stak?

LD: An initial effect would be increased exercise tolerance. That would translate into more intense workouts and better post-training recuperation. A person using it might be able to train faster, with less rest between sets, but that depends on prior physical condition.

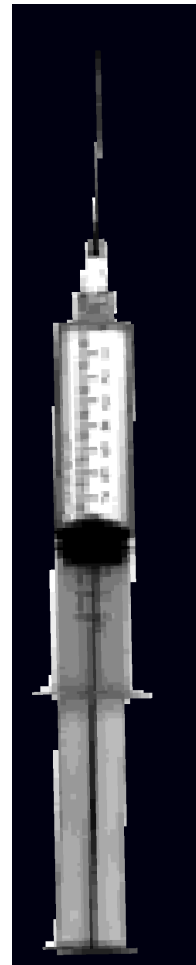
Q: Since GH Stak increases exercise recovery, would a person take it be able to train more frequently or for longer sessions?

LD: While the product does promote greater recovery capacity, it doesn't give you a license to purposely overtrain, either. You still have to use common sense. [GH Stak] will, however, partially compensate for the blunted GH release that occurs with overtraining through an upgraded peripheral IGF-1 synthesis. The localized IGF-1 will serve to maximize muscle repair processes after training.

Q: Since younger people usually have higher IGF-1 levels than older people, what's the advantage for them of using a product such as GH Stak?

LD: Even younger people will show improvements in muscle strength and endurance. Since IGF-1 also strengthens connective tissue, such as that found in joints and ligaments, using the product will offer a degree of protection from injury.

Q: You mentioned earlier that DHEA can also raise IGF-1 levels. Does that mean GH Stak and DHEA are a synergistic combination?



LD: Older people using both show higher IGF-1 levels; however, I believe DHEA use should be reserved for people over age 40. Younger people have higher DHEA levels, making use of this hormone superfluous. I suggest that anyone contemplating using DHEA should have his or her DHEA level measured by lab analysis. That will provide information concerning the proper dose of DHEA to use.

Q: Can using GH Stak lead to a side effect profile similar to that of injected GH?

LD: Carpal tunnel syndrome, a painful wrist impingement, is often a common side effect of GH-injection therapy. With [GH Stak] we've seen this side effect only when people take too great a dose and then only in women. As to the reason the effect occurs only in women, we haven't yet determined it. But the effect is extremely rare and only happens if the product is misused.

Q: Should someone considering GH Stak undergo any prior medical tests?

LD: I'd suggest getting a lab measurement of endogenous IGF-1 levels before using the product so you can see your baseline value of GH response.

Q: Would increasing the recommended dose of GH Stak produce greater effects?

LD: [GH Stak] is a growth hormone modulator. It doesn't give you the constant stimulation associated with GH injections. However, the constant bombardment of GH cell receptor sites that occurs with injections makes the drugs less effective over time. [GH Stak] is more of a gentle stimulus to GH release, but any product that works can be abused.

Q: Is that the reason you suggest cycling and not taking GH Stak every day?

LD: Taking breaks from using the product every few days maintains its effectiveness while also preventing any side effects from occurring. The brief rest periods also maintain receptor efficiency, thus preventing the receptor downgrade that commonly occurs with growth hormone injections.

Q: Are there any known contraindications to GH Stak use?

LD: The only problem we've noticed thus far has to do with the citrus naturally contained in [GH Stak]. People allergic to citrus should not use the product. We do, however, have a citrus-free version coming out soon.

Q: Would GH Stak affect the activity of other hormones, such as

The constant bombardment of GH cell receptor sites that occurs with injections makes the drugs less effective over time. [GH Stak] is more of a gentle stimulus to GH release, but any product that works can be abused.

The greatest physiological GH release occurs during the initial stages of deep sleep, and [GH Stak] will aid the deep-sleep stage as well as provide a synergistic boost to the naturally occurring GH peak at that time.

thyroid output?

LD: We have some evidence that it enhances thyroid output.

Q: *Synthetic GH secretagogues often also increase cortisol and prolactin levels. Would GH Stak share that effect?*

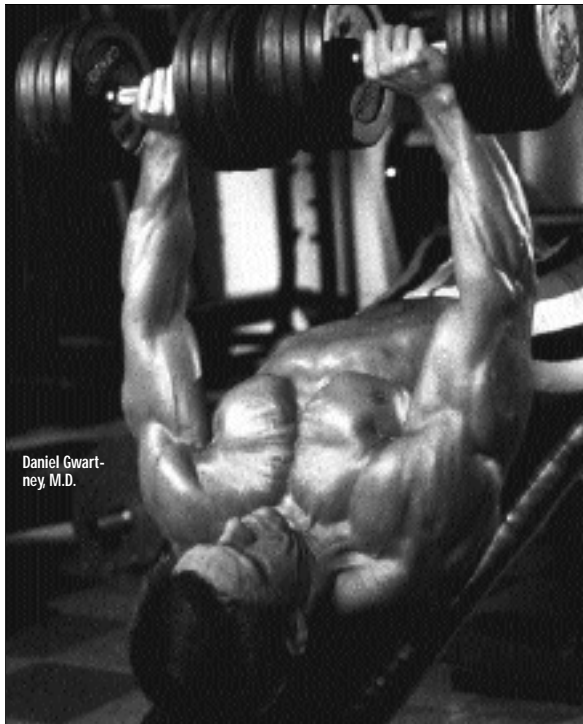
LD: An increased cortisol level would be of concern to athletes because of the established catabolic effects associated with that adrenal hormone. We haven't seen any increases in cortisol levels with [GH Stak] in any age group.

Q: *Why do you recommend against people using artificial sweeteners when they take GH Stak?*

LD: The supplement contains special pharmaceutical sugars that are part of its proprietary chaperon delivery system. Artificial sweeteners interfere with the function of those special sugars, and that could potentially decrease the product's effectiveness.

Q: *Given a choice, is it better to take GH Stak first thing in the morning before eating or at night before bed?*

LD: For most people the better choice is at night. The reasoning here is that in most cases meal consumption has occurred several hours earlier, thus allowing the active elements in [GH Stak] to have a clear pathway to target tissues. In addition, the greatest physiological GH release occurs during the initial stages of deep sleep, and [GH Stak] will aid the deep-sleep stage as well as provide a synergistic boost to the naturally occurring GH peak at that time.



Daniel Gwartzney, M.D.

The Growth Hormone Phenomenon

by Steve Holman

Hormone manipulation may sound like some futuristic concept, but it's here—and it's achieving spectacular results in medicine and athletics. In terms of muscle growth, the technique of boosting testosterone, growth hormone and insulin levels at specific times is becoming the great bodybuilding equalizer. Thanks in part to hormone manipulation, we're now seeing some of the most impressive drug-free bodybuilders that ever walked planet earth. Studies show over and over again that boosting certain hormones can produce results similar to those that occur with anabolic steroid use.

Is hormone manipulation as dangerous as steroid use? Not in most cases. In fact, if you train intensely with weights, you already manipulate your hormones to a degree. Intense weight training increases both testosterone and growth hormone output, which is one reason you get results. If you're like most mass-hungry bodybuilders, however, you're looking to kick up those results a few notches—and perhaps uncover the key to ultimate size and strength.

Your growth hormone level is critical to your getting spectacular results with hormone manipulation. It's the orchestra leader that conducts the other hormones, the quarterback leading the anabolic drive.

For example, a high GH level helps amplify the anabolic response of testosterone, and it can help smother many of the anticatabolic, or anti-muscle-wasting, effects of cortisol. When GH is high, cortisol is low. The anabolic/anticatabolic power of GH makes it the premier bodybuilding hormone, and you should attempt to boost it as often as possible.

How do you up your GH and increase the power of your other anabolic hormones without having to resort to injections? Proper training is the place to start.

Boost Your GH in the Gym

Three training variables have a direct impact on

growth hormone and its positive effects on muscle hypertrophy: intensity, muscle stretch and muscle burn. When you combine them during your workouts, you create an extreme anabolic environment.

Intensity. As James Jamieson, noted pharmacologist and developer of the growth-hormone-boosting supplement GH Stak, and Dr. Lawrence Dorman, a leader in the field of natural medicine, write in their book *Growth Hormone: The Methuselah Factor*, "Sustained high-intensity exercise increases the quantity and number of pulses of GH release. *Intense* is the key word here; garden-variety jogging won't do it." That means you need focused effort on the big compound weight-training movements to affect your GH levels.

Intense effort on the big exercises is vital—for example, squats for your quads, bench presses for your chest, overhead presses for your delts and rows and chins for your back. If you want an increase in GH, use the core movements in the majority of your bodypart programs.

Muscle stretch. Stretch-position movements—such as stiff-legged deadlifts for hamstrings and flies for pecs—can increase the IGF-1 receptors on the muscles. IGF-1, or insulin-like growth factor 1, is a highly anabolic metabolite that can occur as a direct result of higher GH output, and it can have a tremendous positive impact on muscle growth. Here's a list of stretch-position movements for each bodypart. Seriously consider incorporating them all into your program for maximum growth response from your higher GH level.

Quads: Sissy squats

Hamstrings: Stiff-legged deadlifts

Calves: Donkey calf raises, leg press calf raises

Chest: Flies

Lats: Pullovers

Midback: Close-grip cable rows

Delts: One-arm incline laterals

Biceps: Incline dumbbell curls

Triceps: Overhead extensions

Abs: Full-range crunches, Ab Bench crunch pulls

One highly effective way to use these exercises is to do a few sets of the corresponding stretch-posi-

In a study published in the Canadian Journal of Applied Physiology (22:244-255; 1997), researchers showed that there's a direct correlation between higher blood lactic acid levels and GH release from the pituitary gland.

tion exercise at the end of each bodypart routine. For example, end your chest workout with two sets of flies, and on your last set emphasize a stretch-pause on each rep, holding for a four-count in the stretch position before continuing the movement. Stretch-pauses can increase the IGF-1 receptor development and stimulate an even greater anabolic response.

Muscle burn. In a study published in the *Canadian Journal of Applied Physiology* (22:244-255; 1997), researchers showed that there's a direct correlation between higher blood lactic acid levels and GH release from the pituitary gland. That means the more muscle burn you induce, the more growth hormone you can stimulate. To attain the searing effect efficiently, superset two exercises in each bodypart routine. For example, use a multijoint exercise, such as bench presses, followed immediately by a lighter, single-joint, or contracted-position, movement, such as cable crossovers. That superset, a variation of the Aftershock technique, will trigger the higher lactic acid levels you're after.

Put those three variables together, and your GH-boosting quad routine might look like the following:

Squats (warmup)	2 x 15
	2 x 6-9
<i>Aftershock superset</i>	
Leg presses	1-2 x 7
Leg extensions	1-2 x 7
Sissy squats	1 x 12
Sissy squats (stretch-pause)	1 x 6

Here's a sample arm routine:

<i>Triceps</i>	
Decline extensions	2 x 6-9
<i>Aftershock superset</i>	
Close-grip bench presses	1 x 7
Dumbbell kickbacks	1 x 7
Overhead extensions	1 x 9
Overhead extensions (stretch-pause)	1 x 6
<i>Biceps</i>	
Barbell curls	2 x 6-9
<i>Aftershock superset</i>	
Undergrip pulldowns	1 x 7
Spider curls*	1 x 7
Incline curls	1 x 9
Incline curls (stretch-pause)	1 x 6

*Performed on the vertical side of a preacher bench.

You can construct your own bodypart routines, or consult *Compound Aftershock* for more specific GH-boosting programs. See the ad at the back of this book for information.

Supplements to Ramp Up GH: No Injections Necessary

There have been a number of studies showing that specific amino acids, such as glutamine, can boost GH output. One supplement that incorporates the known GH releasers in a powerful compound is GH Stak.

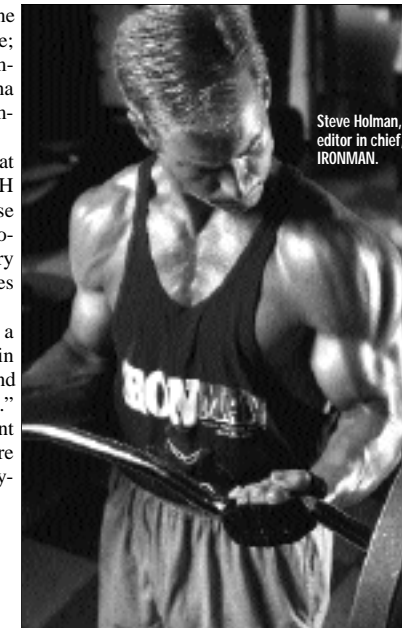
Bodybuilders at the *IRONMAN* Training & Research Center have been experimenting with it—effervescent tablets like Alka Seltzer that you dissolve in water and drink on an empty stomach either before you train or at bedtime. Drug-free bodybuilder Jonathan Lawson made some spectacular gains using GH Stak, adding more than 10 pounds of muscle to his ripped competition weight [see Growth Hormone Q&A]. He competed in 1997 at a bodyweight of just over 180 pounds, and with his first eight-week cycle of GH Stak he boosted that to a ripped-and-ready 195 in early 1998. He got that amazing result due to a number of factors, including the supplement and his high-intensity, full-range training protocol, which incorporated the above concepts. Jamieson has said on many occasions that you get a synergistic effect from the combination of the compounds in the effervescent supplement and the GH-releasing effects of high-intensity exercise. Lawson certainly did.

Why does GH Stak come in an effervescent form? Studies show that there's a significant increase in GH from oral glutamine when the glutamine is in that form—due to pH manipulation in the stomach—and significantly better absorption. The effervescent action also enhances the delivery of the other growth hormone precursors in GH Stak, such as L-arginine, which is included in a more bioactive pyroglutamate form than what you get from standard L-arginine supplements. Other GH Stak ingredients include glycine; tyrosine; Aminotrope 7, a sequenced glycoamino acid complex; and compounds from a legume called the Lacuna bean that's naturally high in L-dopa, a renowned GH-stimulating amino acid compound.

GH Stak also contains anterior pituitary peptides that normalize somatostatin, a hormone that can shut down GH and IGF-1 receptors. That's critically important because when you elevate GH and IGF-1, you don't want somatostatin to smother their effects. GH Stak's anterior pituitary peptides prevent the shutdown, which drastically increases the effects.

As for the research, Jamieson and Dorman presented a study to the American College for Advancement in Medicine, "The Role of Somatotroph-Specific Peptides and IGF-1 Intermediates as an Alternative to hGH Injections." In the 1997 study a group of subjects took the supplement for 12 weeks, and while many were older individuals, there were young bodybuilders as well. Even though body-

You get a synergistic effect from the combination of the compound in the effervescent supplement and the GH-releasing effects of high intensity exercise.



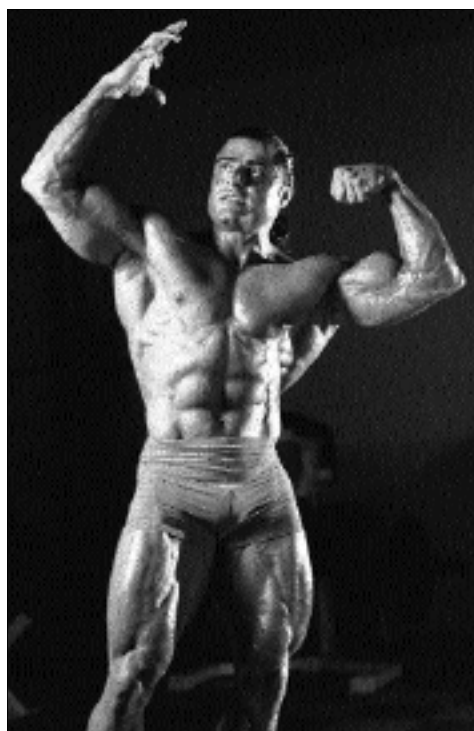
Steve Holman,
editor in chief
IRONMAN.

It's believed that in combination with testosterone and other anabolic, anticatabolic compounds, the muscle-building power of GH is significantly increased along with its fat-burning effects. GH also amplifies the power of many supplements—even protein powders.

builders usually have higher-than-normal IGF-1 levels, the ones in the study still showed anywhere from a 12 percent increase in IGF-1 levels after just one day of using the supplement all the way to a 36.6 percent increase after only six days. Those are some incredible numbers, especially when you realize there was no IGF-1 deficit to begin with. Most of the subjects who had low IGF-1 levels got even better results, with one showing almost a 230 percent increase in only 22 days.

Results with GH Stak have been so spectacular that doctors at anti-aging clinics are using it in place of GH injections. That indicates that the medical community is embracing this supplement as a true alternative. In other words, it works.

Here's the bottom line for bodybuilders. Most pros inject GH, and many experts believe it's the very reason we see such incredibly massive competitors in the sport. It's believed that in combination with testosterone and other anabolic, anticatabolic compounds, the muscle-building power of GH is significantly increased along with its fat-burning effects. GH also amplifies the power of many supplements—even protein powders. It's not hard to see why so many drug-using bodybuilders spend so much money on synthetic GH. If natural bodybuilders are going to come close to mimicking the powerful anabolic effect the pros get with synthetic GH injections and steroids, they'll do it by combining growth hormone boosters, such as GH Stak, with



testosterone boosters, scientifically designed protein powders and cortisol suppressors. Hormone manipulation is the key to rapid drug-free muscle growth, and it's here in full force. It appears to be the anabolic trigger for which natural bodybuilders have been frantically searching.

Growth Hormone Q&A

Q: I've heard that muscle fibers can split, creating more and more fibers in a given bodypart. That would be one reason bodybuilders get so huge—their fibers are multiplying. I also heard that GH may help it occur. How do I make my muscle fibers split?

A: While research hasn't shown conclusively that muscle fiber splitting, or hyperplasia, occurs in humans, animal studies have proved that it does happen within muscle structures. For example, in one study the hyperplasia in rats was the result of stretch overload, which leads me to believe that if it does occur in humans, stretching and stretch-position exercises—like stiff-legged deadlifts for hamstrings, flies for pecs and incline curls for biceps—can contribute to the fiber-splitting phenomenon, resulting in the potential for larger and larger muscles. We already know that stretch-position movements can increase the anabolic receptors on muscle tissue, so the possibility of fiber splitting is yet another reason to use stretch-position exercises for each bodypart.

Other animal-based studies show that the main hormonal stimulus for hyperplasia is IGF-1, which is produced from growth hormone. In *Applied Metabolics #13* Jerry Brainum discusses hyperplasia. He writes that the process "centers on immature, dormant muscle cells termed satellite cells, a reference to their location outside the primary muscle cells. The current theory about hyperplasia is that under intensive exercise conditions satellite cells may fuse with existing muscle fibers and differentiate into new muscle cells or fibers."

Brainum also discusses a new study that points to the IGF-1-hypertrophy-hyperplasia connection. He states that the difference between this study and others is that the doses of IGF-1 used were far lower than what was used in other studies in order to avoid the systemic effects of IGF-1, such as organ growth. You've probably noticed that a lot of pro bodybuilders have distended bellies. Injecting high doses of IGF-1 is probably the reason in most cases.

Here's Brainum's report on the new study: [The researchers] used doses of the hormone that approximated the one produced directly in muscle tissue during the hypertrophy process. This dose produced muscle-size increases in

If hyperplasia does occur in humans, stretching and stretch-position exercises—like flies for pecs—can contribute to the fiber-splitting phenomenon, resulting in the potential for larger and larger muscles.



Arginine increases the production of nitric oxide, which can relax and help dilate blood vessels. In other words, with more nitric oxide you get better pumps in all of your bodyparts, even the ones you train in the bedroom.

the specific muscle of the rat that the hormone was infused into. The main point of the study is that IGF-1 works to increase muscle growth most efficiently when it's produced locally in the muscle rather than injected systemically. A high-protein diet and possibly certain GH-stimulating amino acids combined with heavy-load weight training are probably the best way to increase localized IGF-1 synthesis in the muscle.

Those concussions suggest that taking a growth hormone booster prior to high-intensity workouts is best. While it's somewhat uncomfortable if you don't eat for two hours prior to a workout so you can take the GH Stak on an empty stomach, the results will probably be worth the hunger pains. The difference is that using the supplement right before a heavy weight-training session helps increase localized IGF-1 synthesis in the muscles being trained in the workout, which is how the researchers triggered muscle growth in the rats in the study. Taking GH Stak before bed doesn't produce those effects.



—Steve Holman, editor in chief, IRONMAN

Q: *I'm 45 years old and have been using GH Stak for about four weeks. I'm making some great gains in the gym, but I've also noticed an increase in the number of erections I'm getting. Is GH Stak the natural answer to Viagra?*

A: Maybe so. There have been a number of reports tying GH Stak to new hardness in that undertrained area (at least most men feel it's undertrained). It may be because the supplement contains pyroglutamate arginine, which is a potent form of L-arginine that's made even more effective by the effervescent delivery system.

Arginine increases the production of nitric oxide, which can relax and help dilate blood vessels. In other words, with more nitric oxide, you get better pumps in all of your bodyparts, even the ones you train in the bedroom. Of course arginine also helps increase growth hormone output, but us older guys can appreciate the increase in hardness everywhere. Who needs Viagra?

Incidentally, foods that are rich in arginine include most seeds, nuts

and legumes, but the arginine in plants is contained within the protein structures, so you probably won't get quite the same effect as you do when supplementing with the free amino acid, and taking L-arginine capsules probably won't be as effective as the pyroglutamate arginine in GH Stak.

—Steve Holman, editor in chief, IRONMAN

Q: *You've written that the trainees at the IRONMAN Training & Research Center use GH Stak and have gotten great results, but I've seen some other GH releasers advertised that are less expensive. Are they the same thing?*

A: I've tried GH Stak, a.k.a. Pro hGH, and gotten some very good gains, especially for someone my age, 39, and training level. Jonathan Lawson, one of the trainees at the IRONMAN Training & Research Center, has also been using it, and he achieved almost a 15-pound bodyweight increase from his first eight-week cycle with noticeably more cuts and striations, which means he was losing fat as he gained muscle (see his before and after shots below).

I also know that GH Stak has a patented delivery system that makes it superior to any other GH booster around, and it also contains compounds that suppress somatostatin, a hormone that can hinder the anabolic effects of GH.

Finally, I know that the developer of GH Stak, noted pharmacologist James Jamieson, who also developed the patch-delivery system for drugs, is filing lawsuits against a number of companies that advertise their product as having the same delivery system as GH Stak when they actually don't.

After considering the above facts, you may or may not want to try one of the cheaper knockoff products. The choice is yours. From what I understand, most of them are simple mixtures of a few specific amino acids, concoctions that get severely degraded by stomach acid because they don't have a protective delivery system.

—Steve Holman, editor in chief, IRONMAN

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Before and after GH Stak. The photo of IRONMAN Training & Research Center member Jonathan Lawson at right was taken after he competed at a bodyweight of under 185. The photo at the far right was taken a few months later, after his first eight-week cycle of GH Stak. He weighed around 200 pounds—about a 15-pound gain. Notice that he's just as ripped and vascular but much fuller. Also keep in mind that the after photo was taken with no tanning preparation, no oil and with only available light, not the flattering studio lighting used for the other photo.





***Fat Burners:
Adios Adipose***



Guggulsterones: Turn Up the Heat to Burn More Fat

by Derek Cornelius

C*ommiphora mukul* is an herb known as guggul. Just as that plant has unique and interesting names, so it also has unique and interesting effects on the human body.

Guggul is a tree that grows in India that exudes a resinous sap from its bark. The resin has been used for centuries in India's traditional Ayurveda medicine. In our modern world of advanced chemistry the sap is processed and purified and then standardized for its active constituents—Z and E guggulsterones. The two compounds are plant sterols that have a high degree of human bioactivity and have been shown in studies to affect many biological processes, including thyroid metabolism, cholesterol management and dermal, or skin, function. In each of those areas guggulsterones were shown to be highly effective modulators with near-druglike potency.

Bodybuilders are concerned with not only building solid muscle tissue but also reducing the amount of fat deposits. You may weigh 240 pounds and have a tremendous amount of muscular development, but if you have two inches of subcutaneous fat all over your body, you won't look all that great. You definitely won't be aesthetically pleasing, and some people might even call you dough-boy. A thyroid-stimulating substance might be exactly what you need.

I first became interested in guggulsterones when I noticed studies on their thyroid-stimulating properties. I discovered that guggulsterones have a direct stimulating action on the thyroid gland through enzymatic mechanisms. One study concluded that they're a viable option for the treatment of hypothyroidal conditions. The warm feeling, the sweating and the rise in body temperature confirm guggulsterone's thyroid-stimulating ability. That's good news for those of us who are trying to lose weight—especially adipose tissue, or fat stores. When the thyroid gland is stimulated, it produces more thyroid hormones, such as thyroxin, which

have a profound effect on the rate of metabolism, including a direct catabolic effect on adipose tissue. That means guggulsterones will stimulate your thyroid to produce more thyroid hormones, which in turn will raise your metabolic rate and burn more fat.

Guggulsterones by themselves have been shown to work very well for fat loss, but I've found a combination that's nothing short of amazing—guggulsterones and an ECA stack such as Adipokinetix. We already know that Adipokinetix is an extremely potent fat burner, but it does its work outside the realm of the thyroid. It made sense to me that if one could combine the fat-burning effects of the thyroid hormones with those of the adrenergic hormones (e.g., adrenaline), something very dramatic would result. Also, ECA stacks tend to decrease the amount of thyroid hormones circulating in the blood over time. Guggulsterones do a great job of inhibiting that reduction, thus keeping all physiological fat-burning systems operating at a maximum level.

The final ways in which guggulsterones can benefit in the fight to burn fat involve ketogenic diets and growth hormone use. Over time ketogenic diets tend to reduce the thyroid's effectiveness by reducing the conversion of T4 to the more potent T3. Guggulsterones won't do anything to increase the conversion, but they will cause more T4 release, which in turn should increase T3 to some extent. Furthermore, although T4 is not as potent a metabolic regulator, it is functional and should inherently help boost the metabolic rate. Regarding GH use, anyone who has taken this potent hormone knows that it vastly reduces the amount of thyroid hormones that are produced by the thyroid gland. Again, although I've never tried it and don't know of anyone who has, guggulsterones should help lessen the thyroid-hormone-reducing effect.

Although their fat-burning properties are what we're most interested in, guggulsterones also have an extremely beneficial effect on cholesterol and

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triglyceride levels. Numerous clinical studies have shown that they cause a 14 to 27 percent decrease in total cholesterol in a four-to-12-week period, while triglyceride levels drop 22 to 30 percent. Even more interesting is the fact that guggulsterones support a high high-density lipoprotein (HDL), or "good" cholesterol, level and a low low-density lipoprotein (LDL), or "bad" cholesterol, level. Study after study confirms that guggulsterones are as potent as many of the current prescription drugs for lowering LDL cholesterol. Unlike their drug counterparts, though, guggulsterones have absolutely no negative side effects.

The cholesterol-reducing effect is important for anyone who's interested in keeping a healthy cardiovascular system—especially those who use steroidal compounds. Anabolic/androgenic steroids increase not only total cholesterol but also the ratio of LDL to HDL.

It's hard to imagine a compound that beneficial having any more benefits, but guggulsterones have also been proven as effective as the drug tetracycline in treating acne. In a 1994 study published in the *Journal of Dermatology*, 20 patients with nodulocystic acne were randomly given either tetracycline or guggulsterones. Both were taken daily for three months, and both produced a progressive reduction in the lesions in the majority of the patients. Tetracycline reduced them by 65.2 percent, while the guggulsterones produced a 68 percent reduction.

Who can benefit from guggul's effects? Well, who wouldn't like a better complexion? That's especially true for people on anabolic/androgenic steroids, as those drugs tend to increase the skin's oiliness and potential for acne.

Where else can you find a compound that will help you lose fat, improve your cholesterol profile and at the same time improve your complexion?



I've looked long and hard and have yet to find even one competitor. You should take 30 to 60 milligrams three times per day with meals, and always use a product that contains the high-potency, naturally extracted guggul.

Editor's note: *Derek Cornelius is a respected biochemist and the owner of Syntrax Innovations Inc.*

Adipokinetix: Faster Fat Burning Through Biochemistry

Adipokinetix is a supplement that mobilizes and burns fat tissue without sacrificing muscle and organ tissue. You should be familiar with the ECA stack—a combination of ephedrine, caffeine and aspirin. Adipokinetix is similar to ECA but is a vast improvement. It takes fat mobilization and burning to a new level. Adipokinetix contains precise ratios of 1R,2S norephedrine HCl, caffeine, yohimbine HCl and now 50 milligrams of theophylline. The aspirin is left out because some people are sensitive to it. Furthermore, aspirin is cheap, easy to get and can be easily added to the stack if you can tolerate it.

The first two compounds—1R,2S norephedrine and caffeine—work together in much the same way ephedrine and caffeine work. The difference is that studies have shown norephedrine to be the most potent and most thermogenic of the ephedrine alkaloids. Norephedrine also lacks some of the central-nervous-system-stimulating effects of ephedrine. In practical terms that means an individual will still feel a little wired but not nearly as much as he or she will feel with ephedrine. Another plus for norephedrine is that it doesn't have the negative associations that ephedrine has—there are no Food and Drug Administration restrictions and no negative publicity. In the coming years norephedrine will definitely be the compound of choice for easy, effective weight loss—instead of the ECA stack, you'll hear about the NCA stack.

Norephedrine and caffeine work synergistically to drastically increase the body's production of adrenaline and norepinephrine—the adrenergic hormones—which bind to the adrenergic receptors. There are a number of different adrenergic receptors: the alpha sub 1, alpha sub 2, beta sub 1, beta sub 2 and beta sub 3. We are mainly interested in the alpha-sub-2, beta-sub-2 and beta-sub-3 receptors—for they're the ones that mainly affect fat loss and mobilization.

Among other things, the beta-sub-2 and beta-sub-3 receptors are responsible for the mobilization and burning of adipose tissue; so they are the receptors that you want to

stimulate, for they ultimately affect fat loss in a positive way. Another positive benefit of stimulating the beta-sub-2 receptors is an anticatabolic effect on proteinaceous tissues. Thus, you simultaneously lose fat without sacrificing much or any muscle tissue.

The other receptor that we're interested in is the alpha-sub-2 receptor. Studies have shown that it blocks the mobilization of adipose tissue. In terms of fat loss it's the bad

guy. In fact, it's the receptor that causes women to have a harder time losing adipose tissue—especially in their lower bodies. Women have many more alpha-sub-2 receptors than men, and they have an even greater number in their lower bodies. To combat those nasty receptors, we need a compound that's naturally occurring, easy to get, potent, lacking negative side effects and able to block them. Yohimbine is the answer.

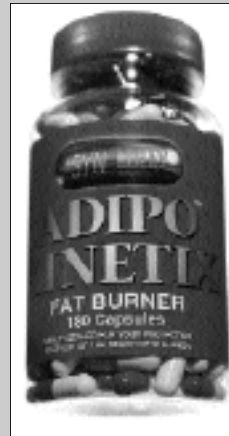
Yohimbine does all of the above with an added bonus—it's a proven aphrodisiac. Thus, with Adipokinetix you can lose fat, preserve muscle tissue and at the same time increase your sex drive—regardless of your gender. Both men and women benefit. Yohimbine vastly improves the effectiveness of the norephedrine and the caffeine by allowing the increased adrenergic hormones to do their job. Basically, it cripples your body's negative feedback loop for maintaining your bodyfat.

The new formula also includes 50 milligrams of theophylline per capsule. The interesting thing about theophylline is its potent diuretic effect. When it's used in combination with an ephedrine alkaloid, a dual leaning effect ensues—you burn excess bodyfat and eliminate excess fluid, reducing fluid retention.

Currently, there's no other product on the market like Adipokinetix. It's unique and destined to be the future of fat-loss pills.

—Derek Cornelius

Editor's note: *Adipokinetix is available from Home Gym Warehouse, 1-800-447-0008.*



Home Gym Warehouse 1-800-447-0008

Boost Your Stagnant Metabolism

by Daniel Gwartney, M.D.

Losing bodyfat is one of a bodybuilder's main goals—and possibly the most frustrating. After long periods of dieting you often hit a plateau. What happens when fat loss comes to a screeching halt? You redouble your efforts. You fumble around with your diet, supplements, cardio and so on, trying to increase your caloric expenditure and metabolic rate.

Despite the best intentions, however, many of those efforts are self-defeating. People who are trying to lose weight often experience a decrease in basal metabolic rate, or BMR, which is the number of calories you burn at rest. The frustrating part is that it happens following long periods of low-calorie dieting; stimulant use, including ephedra and caffeine; and excessive physical activity. Do any of those scenarios sound familiar?

The decrease in BMR is directly related to the level of thyroid hormone activity, which refers to the levels of two hormones released by the thyroid gland, thyroxine, or T4, and triiodothyronine, or T3. T4 is a low-activity thyroid hormone, and T3 is a highly active one. The overall thyroid hormone activity involves the total amount of thyroid hormones and their relative proportions. Optimal thyroid activity depends on necessary levels of the hormones and the rate of conversion of T4 to T3.

Most thyroid hormone is released in the form of T4 and needs to be converted to T3, a process that takes place in the liver and is regulated by caloric intake, rather than caloric expenditure. In simple terms, if you are bringing in lots of fuel—i.e., food—you can turn up the heat, literally and figuratively. If, however, you aren't bringing in enough calories, your body turns its thermostat down and you burn fewer calories. It makes sense, especially if you think of long-term survival.

So what can you do? Some advances have been made in terms of useful training methods and supplements. You can do your cardiovascular work first thing in the morning, possibly after consuming 200 to 400 milligrams of caffeine, along with plenty of water. Unfortunately, some of the effec-

tive thermogenic supplements have been taken off the market. The ECA (ephedrine, caffeine, aspirin) combinations provided good results for many people, but some people abused them. Most of the other so-called fat-burners lack much promise.

Some products have been shown to be effective, including essential fatty acids, soy-protein isolates and the use of low-glycemic-index carbohydrates. New, theoretically thermogenic combinations are being introduced almost daily, including such agents as yohimbine, tyrosine and phenylalanine. Typically, they are added to ECA or a chemically related compound like synephrine or pseudoephedrine, so we may end up seeing the same problems.

All of those products, with the exception of soy-protein isolates, interfere with thyroid activity. That fact led to the development of Thyro Stak. It includes five ingredients that have been shown to support or enhance thyroid activity even in low-calorie environments.

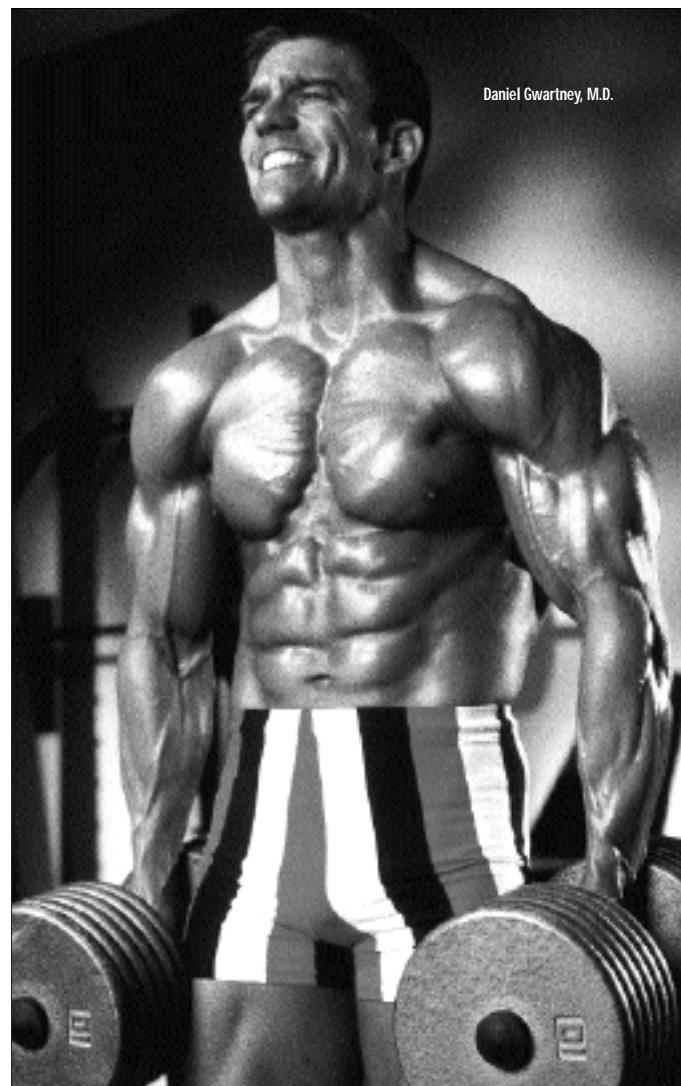
The main ingredient is an herb that has received little attention in Western medicine, though it's been used in Ayurvedic medicine for many centuries. *Commiphora mukul* contains a class of active compounds known as guggulsterones,^{1,2,3,4,5,6} and, while there isn't a great deal of published research on the compounds, what there is indicates that guggulsterones, specifically guggulsterones Z and E, have thyroid-stimulating activity.^{5,6} Subjects in those studies showed an increase in thyroid hormone levels and an increase in the conversion of T4 to T3. They showed lower cholesterol and blood triglyceride levels as well, further indicating increased thyroid activity.

Thyro Stak also contains phosphates, which are found in such high-energy compounds as ATP and phosphocreatine. Thyroid activity is closely linked to the amount of energy you have, so it's a good idea for everyone to take an ample amount of phosphates daily. Numerous studies have shown the effect of phosphate supplementation on metabolic rate. Of particular interest is a study published in 1996, which demonstrated that phosphates can pre-

vent a decrease in T3 and an increase in resting metabolism in subjects who are on low-energy diets.⁷ That, in addition to phosphates' positive effects on creatine storage, buffering lactic acid and increasing ATP, firmly establishes the value of including phosphates in Thyro Stak.

The product contains niacin, selenium and magnesium. Niacin plays a role in supporting the co-factors necessary for energy production, such as NAD(H) and NADP(H). More than 200 enzymes require NAD and NADP. NAD is involved in energy production, while NADP(H) is

If you aren't bringing in enough calories, your body turns its thermostat down and you burn fewer calories. It makes sense, especially if you think of long-term survival.



Thyroid activity is closely linked to the amount of energy you have, so it's a good idea for everyone to take an ample amount of phosphates daily.

used in a variety of processes, including fatty acid synthesis, glutamate oxidation and antioxidant activity. Niacin has also been shown to decrease cholesterol levels. Some people are sensitive to the flushing effect of high doses of niacin, but the effect is short-lived, and it's possible to build up a tolerance with continued usage.

Selenium is a mineral that has received a great deal of attention in recent years. Selenium appears to have a major regulatory impact on the enzyme 5'-deiodinase, which converts T4 to T3.⁹ Low levels of selenium can impair thyroid conversion—but excess selenium also has a negative effect on thyroid conversion.

Magnesium is present in more than 300 identified enzymatic reac-



tions.¹⁰ It's involved in glycolysis, the Krebs cycle and creatine phosphate production, among others. Magnesium even has a role in protein synthesis. Subjects in a 1992 study showed increases in strength and lean body mass after a few weeks of increasing their magnesium intake.¹¹

There are a lot of valuable products available to bodybuilders these days. Thyro Stak is the first supplement designed to optimize thyroid function and metabolic control, and, as such, it can help you break through those maddening diet plateaus.

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Magnesium even has a role in protein synthesis. Subjects in a 1992 study showed increases in strength and lean body mass after a few weeks of increasing their magnesium intake.

Burn More Fat With Ephedrine and Ephedra

by Dan Duchaine

If Laura Fraser, the *Good Housekeeping* writer who recently surveyed the most popular natural diet aids,¹ wanted to be objective about ephedra, she could have looked up the word in a Chinese dictionary. *Ephedra*, roughly translates to “astringent” and “yellow.” Instead, Fraser likes another definition for the Chinese herb: “legalized speed.” Mainstream America has discovered a better, nonprescription fat-burning pill than the recently withdrawn dexfenfluramine (Redux), but a barrage of government-sponsored misinformation—paid for by our tax dollars—is contradicting 75 years of scientific research, not to mention 5,000 years of safe use in Chinese medicine! It’s time to set the record straight, starting with giving credit where credit is due: The man who turned on the American public to this thermogenic health food is Paul Delia, a bodybuilder and gym owner from Pascagoula, Mississippi, who’s also the owner of the supplement company AST Research.

Coulda Been Kazabol

“Matter of fact, I wasn’t thinking about thermogenesis,” Paul said. “I just wanted to be kick-ass strong in the gym, but I didn’t wanna go fruitcake with amphetamine use, so I started looking into the body’s closest thing: adrenaline. I stumbled onto ephedrine back in ’87. I read that it was a milder but longer-lasting form of adrenaline, the body’s numero-uno fright, flight or fight hormone. So I asked the Food and Drug Administration (FDA) how I could sell ephedrine, which was an over-the-counter asthma medicine at the time. What a pain! The label had to have specific words, in a type that was a certain size. I even had to have an FDA-approved label glued on—and it had to be bombproof so it wouldn’t fall off. I was determined, though, and Dymetadrine 25 was launched.”

The problem with over-the-counter, refined ephedrine, is that you can’t stack just anything in

the tablet with it, unless you get an FDA approval for the combination, like the ephedrine-and-theophylline combinations in Bronkaid and Primatene tablets. Right after AST’s Dymetadrine 25 sales started shooting through the roof, Cybergenics put out an herbal capsule stack containing ephedra, the unrefined—and, more important, unregulated—herb stacked with caffeine and called it Cyber-Blast. Before then I’d thought that all Cybergenics products were crap, but I had to admit that Cyber-Blast was pretty good. It was a sneaky way of stacking ephedrine and caffeine without the FDA’s butting in—and keep in mind that up to this point nobody had yet mentioned fat burning. I knew that many health food stores were reluctant to sell pure ephedrine, and even Cyber-Blast looked too drug-like for them; so in 1992 Next Nutrition’s David Jenkins and I resurrected my 10-year-old Ultimate Orange and called it “Tang With a Bang.”

In the ’80s hardcore bodybuilders had this maxim: Real bodybuilders don’t read—let alone believe—scientific research. It was very hard to look things up back then—before at-home Internet Medline access. We had to go to the medical libraries and pour over hundreds of bound volumes called *Index Medicus*—and all we found out was that “Steroids don’t work.” If I’d been really on the ball back then, I would have known about the extensive history and refinement of the ephedrine-and-caffeine thermogenic stack, but I was a know-it-all, a dumbshit. Rather than discuss the research in the haphazard way I discovered it, here’s a chronological outline of the scientific developments regarding ephedra and ephedrine.

It’s Not Some Pinko-Commie Plot

Ephedrine is a white, refined nonprescription drug. Ephedra is a soot-colored herbal, and there are numerous ephedra varieties—about 40—that are grown in many desertlike climates. In America we have a variant called *Ephedra nevadensis*, also

known as Mormon tea. Unrefined ephedra has two distinct isomers, l-ephedrine and d-pseudoephedrine. For example, the Chinese mahuang (*Ephedra sinica*) is mostly l-ephedrine. Mormon tea, though, is mostly the much-less-stimulating d-pseudoephedrine. So, when you buy the herbal variety, you get some pseudoephedrine with your ephedrine.

The ephedrine alkaloid (2-methylamino-1-phenyl-1-propanol) was introduced in the Western medical community in 1923.^{2,3} As its potency is about 85 percent that of the body’s noradrenaline (in itself a weak adrenaline), people tried ephedrine for a host of illnesses over the years: asthma, heart block, narcolepsy, depression, hypotension⁴ and some forms of insulin-induced edema.⁵ At present the approved use of ephedrine is for mild asthma.

Hamlet’s Hometown Hits the Big Time!

The first instance of ephedrine being used as a weight-loss drug took place in Elsinore, Denmark, in 1972.⁶ Dr. Eriksen, a general practitioner working in the small town, had noticed that many of his asthmatic patients had reduced appetites when they used a triple stack of ephedrine, caffeine and phenobarbitol. The narcotic was included to quell the jitters—or it was a canny business move aimed at hooking the patients into buying more. By 1977, 70,000 people were taking the so-called Elsinore pill. That same year the Danish government issued a “cease-prescribing” warning to all doctors about the product after a number of skin rashes, attributed to the phenobarbitol, were reported.

Dissin’ Doc Eriksen

The revival of ephedrine and caffeine as an obesity-fighting drug has been an unusually long and cautious process, considering there are nu-

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merous studies from 1923 onward showing the effects of ephedrine and methylxanthines (caffeine and theophylline) on bronchial dilation in humans. Even Dr. Eriksen didn't make the connection that ephedrine and caffeine formed a thermogenic compound that increased energy expenditure. He thought it was simply an appetite suppressant. It wasn't until 1981 that a traditional research study "proved" that ephedrine with caffeine reduced appetite.⁶ Before that academia stalled the research, invoking the infamous NIH clause: Not-Invented-Here. Poor Doc Eriksen was the Rodney Dangerfield of the fat-loss field.

Bat-Man (No, Not the Pedophile in the Comic Books)

From the late '70s the research was showing that ephedrine causes energy expenditure in various laboratory animals, but it took about nine years for human studies to tart appearing.^{7,2,8,9} Obscuring the central issue was a debate that was going on at the same time about the existence in humans of brown adipose tissue (BAT), which is a heat regulator in many mammals. Some of the initial research was incorrect in showing that humans had BAT between their shoulder blades, as the heat increase that appeared to take place was due to increased blood flow. Humans do have a small amount of BAT surrounding their kidneys,¹⁰ but its thermogenic effect on the whole body is small.

When scientists agreed that ephedrine was thermogenic in humans, they still had no firm recommendations of ephedrine dosage. Some studies showed the best thermogenic response at the lowest dosage, 10 milligrams.² Others showed that 20 milligrams created no increase in heat.

If It Works for Asthma...

You'd think that a scientist would have thought of the obvious sooner: If ephedrine and caffeine combinations work well together in treating asthma, they should be similarly effective for thermogenic benefits. Caffeine is thermogenic at the higher dosages,^{11,12,13,5} so the ephedrine-and-caffeine stack should have at least an additive thermogenic effect.^{14,15,16,17,9,18} It was only in 1992 that a team of Danish researchers established the ideal synergistic ratio of ephedrine to caffeine at 1-to-10.² They tried other ratios but discovered that 20 milligrams of ephedrine gets a maximal thermogenic effect with 200 milligrams of caffeine. Note tht those were the amouyns used in the '92 study. Many bodybuilders tend to double the dose to 40 milligrams and 400 milligrams, but there's no evidence that the greater amounts cause a greater energy expenditure. Then, again, some people do it that way because they like it.

The ECA Stack Is Iffy

Methylxanthines weren't the only substances that showed promise when they were stacked with ephedrine. There was also aspirin. The studies are wildly conflicting on that subject.^{19,20} An initial study in the '80s showed a doubled thermogenic response in obese women, but another similar experiment showed no enhanced effect in lean women. What's more, although many of the popular herbal ephedrine stacks include the aspirin precursor white willow bark, there are no published studies showing that ephedrine, caffeine and aspirin are any better than ephedrine and caffeine alone.²¹

So What's the Damn Problem?

If ephedrine has been around for so many years, and the research shows it to be effective and safe for weight loss, why is it that *Good Housekeeping* and the FDA have a vendetta against the ephedrine-and-caffeine stack? Many doctors like to say that it's dangerous, but they're the same doctors who embraced dexfenfluramine, even though the published research showed that ephedrine and caffeine was not only more thermogenic but was longer lasting as well (50 weeks vs. Redux's six-month-only effects).¹⁰ I don't usually cast stones, but we wouldn't have an ephedrine problem if Herbal Ecstasy hadn't become so popular.

When ephedrine was used only by asthmatics, truck drivers, athletes and dieters, it was pretty much below the horizon of public scrutiny, but the Herbal-X variants appealed to the worst possible segment of the population: adolescents. Many teenagers have a veneer of invulnerability, especially if a powerful stimulant is declared to be "all natural" and so, presumably, safe. Teenagers plus natural high equals abuse plus emergency room visits. Although I'm no friend of the FDA, I feel that the agency could have moved faster against those Herbal-X-type products, the way it did when the herbal fen-phens hit the market.

The FDA can't ban ephedrine outright, but it can control the claims made on the labels. The agency has been threatening to take control of herbal ephedra—calling for a maximum dose of eight milligrams, not allowing it to be combined with additional stimulants and requiring with a label warning that users should take no more than three doses a day. The way the FDA arrived at those doses is not, obviously, based on any published research. Fortunately, at this point ephedrine-and-caffeine stack is still here.

How Ephedrine Really Works

If you didn't have a sympathetic nervous system, which branches off your middle spinal column, ephedrine wouldn't work. No matter, as you'd be dead anyway. The sympathetic nervous system controls all those automatic bodily functions you don't think about: heart rate, res-

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piration, perspiration, even bowel movements. One of the more interesting aspects of the sympathetic nerves is what they do when you eat too many carbohydrates. Beyond the digestion energy and glucose being converted into either glycogen or triglyceride, some of the extra calories are burned off as heat.^{22,7,8} It's the thermogenic effect of carbohydrates—though, technically, it's insulin that trips the thermogenic switch. The sympathetic nerves secrete a milder form of adrenaline called noradrenaline, which needs hormone receptors to work. The receptors in question are called adrenergic receptors, and the human body has two main types and a number of further subdivisions: alpha (1 and 2) and beta (1, 2, 3, and 4).

In animals, switching on the beta-receptors with noradrenaline via insulin burns excess fat calories in beta-1, -2 and -3 receptors, especially in the BAT areas. Humans, having very little BAT, mostly burn glucose and glycogen in skeletal muscle and the liver in something called the Cori cycle, in which carb calories are converted to lactate, and recycled back into glucose and glycogen in the liver.^{23,10}

Ephedrine was originally thought to be simply a stimulator of noradrenaline secretion from the sympathetic nerves. Further research showed that it also acted directly on the adrenergic receptors—mostly the betas but with some alpha effects as well.

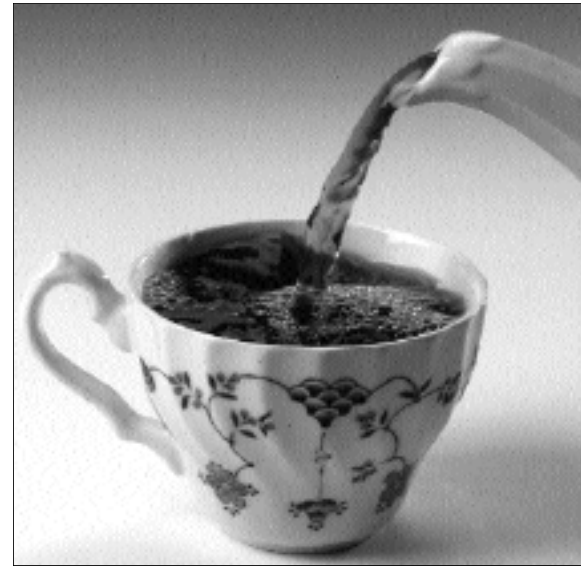
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The odd thing is that ephedrine is considered a fat burner, but it does that by using up the glucose and the glycogen in the skeletal muscle and liver. Only an insignificant amount of direct fat burning occurs in the BAT around the kidneys.

Ephedrine actually raises both blood glucose and insulin.²⁴ Most low-calorie diets can cause increased nitrogen excretion, but just the opposite happens when you add ephedrine to the low-calorie equation. The effects are similar to those of growth hormone or people on a low-calorie diet: It makes the body rely on fat calories without sacrificing amino acids in the muscle for glucose production.

Where Does Caffeine Fit In?

The body has built-in regulating mechanisms so that noradrenaline secreted from the sympathetic nerves is modulated in its effect. Methylxanthines all seem to work on one of the energy precursors in the cells, cyclic adenosine-monophosphate (cAMP), in conjunction with the increase in cAMP due to the effect of noradrenaline on the beta-2 receptors. There was a debate over the years as to what the primary action of the methylxanthines are: They either block adenosine or inhibit phosphodiesterase (PDE), the enzyme that degrades the phosphate in cAMP. Caffeine has both effects, but PDE turned out to be the



primary substance that intensifies ephedrine's thermogenic effect.¹³ Chemists have produced better caffeine derivatives that have greater PDE inhibition (the most promising is enprofylline), which doesn't influence heart rate as much, but none of the methylxanthine derivatives have been approved yet. Other substances, like forskolin, can potentiate ephedrine, forskolin has a greater adenosine-blocking effect while affecting the heart more.²⁴

What About Aspirin?

The transient autocrine hormones called prostaglandins can, in some cases, inhibit the release of noradrenaline. As mentioned above, some obese women respond dramatically to aspirin stacked with the ephedrine in studies, while less obese women didn't fare as well. You don't have to wait for further studies to find out what works for you. Once you've established a consistent body temperature rise with ephedrine and caffeine (a \$6 digital mouth thermometer will give you the info nicely), you can try adding 300 milligrams of aspirin and see if your body temperature shows an increase from the previous ephedrine-and-caffeine elevation.

The Really Weird Stuff About Ephedrine

The adrenergic receptors are distributed through most cells and organs in the body. At times the beta stimulation from ephedrine can actually increase some hormones. For example, thyroid hormone is elevated after about four weeks of chronic ephedrine use. Get this, however: After 12 weeks of ephedrine use thyroid hormone is lower than nor-

Thyroid hormone is elevated after about four weeks of chronic ephedrine use. Get this, however: After 12 weeks of ephedrine use thyroid hormone is lower than normal—but thermogenesis is greater than it was during the initial metabolic rise.

One of the chief drawbacks to most low-calorie diets is the reduction of high-density lipoprotein (HDL), the so-called good cholesterol. Adding ephedrine to a low-calorie diet restores HDL to near normal levels.

mal—but thermogenesis is greater than it was during the initial metabolic rise. What the hell is happening?

Eventually, many of the beta-1 and beta-2 receptors will resist the ephedrine and noradrenaline stimulation, but the body won't freeze you solid. When beta-1s and beta-2s are downregulated, another thermogenic receptor increases. When that odd effect was reported in humans in 1995, the researchers assumed it was the fat-burning beta-3 receptor.²⁶ Recently, however, the beta-3 premise was discounted when the human-specific beta-4 receptor was discovered.

More Information

Studies have shown that only caffeine—and none of its metabolites, the chief one being paraxanthine—is thermogenic with ephedrine. What's more, research shows that part of the grapefruit rind called naringin puts off the breakdown of caffeine to paraxanthine—and grapefruit blossoms are even better—so some ephedra stacks have that additive.

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The DEA Plays Hardball

The United States Drug Enforcement Agency (DEA) doesn't like ephedrine. Technically, a smart criminal chemist can make ephedrine into amphetamine. To thwart that, many of the refined ephedrines contain another ingredient that makes them almost impossible to convert: guaifenesin (a mucous-expeller, yuck!). Since the summer of 1997 the DEA has required that all interstate shippers of ephedrine register with the agency. A health food store doesn't need a DEA license to sell ephedrine for in-store sales, but anyone who wants to sell it to out-of-state customers via mail order has to have that license. The punch line is, the DEA stopped the issuing licenses after August '97.

Worst-Case Scenario

What will happen if the FDA gets every one of its proposed regulations governing ephedra approved? Will products like Ultimate Orange or Twinlab's Ripped Fuel become illegal? Not to worry: There are plenty of other naturally occurring compounds just as potent as ephedrine and caffeine—or more so.²⁷

What About Herbal Fen-Phen?

In essence, the various herbal fen-phen's are in the spirit of the origi-

nal Elsinore pill: two stimulants (ephedra and caffeine) with a mild antidepressant (Saint-John's-wort). While there's no research showing that the antidepressant makes a stack more thermogenic, overstimulation caused by the ephedrine and caffeine is a very valid complaint from many users. I wouldn't be surprised if one of the anti-anxiety herbs like red ginseng didn't turn out to be a better choice.

Bottom Line: The Best Ephedra Stack, Bar None

Here are some tips for finding a good product.

1) Read the label thoroughly. Ephedras can vary in potency. Multiply the total ephedra per dose by the potency percentage to determine the amount of active ephedrine (335 milligrams of raw ephedra times 6 percent gives you 20 milligrams of active ephedrine). The ideal dose for the thermogenic effect is to take about 20 milligrams three times a day, or every six hours. If you use more, you may get a better workout due to more contractile force in the muscles, but you won't necessarily get a better thermogenic effect.

2) The caffeine dose should be 10 times the ephedrine dose. You'll have to do the same arithmetic to arrive at the active caffeine content. The two chief sources of herbal caffeine are kola nut and guarana.

3) Once you establish a consistent body temperature elevation with ephedrine and caffeine, you can try 300 milligrams of aspirin to see if you get a further thermal enhancement.

4) Refined naringin is not generally available. If you want to try a grapefruit juice chaser, the more bitter the better.

5) Take the product continuously for a while—don't stop for a while. Ephedrine-caffeine thermogenesis is better at 12 weeks and is still significant at week 50! If the animal-based research holds true, downregulating the beta-1 and beta-2 receptors creates more true fat-burning receptors in the body.

6) The ephedrine-and-caffeine combination has proven unusually safe over the years. Some individuals who are prone to cardiac ailments, hypertension and other medical conditions should stay away from all stimulants. Yes, strokes and heart attacks have occurred while people were using ephedrine—and some cases the victims were seemingly healthy individuals. It appears to be a random occurrence. One case of death from stroke involved a man who used 10 to 20 25-milligram ephedrine tablets a day for 23 years, while another fatality occurred with a healthy 15-year-old football player.

Just remember that herbs and plants are potent drugs. Bodybuilders and dieters have access to a vast unregulated pharmacy called a health food store; however, the drugs are only safe when used with caution and common sense. But don't wait for the *Good Housekeeping* Seal of Approval.

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Fat-Burning Q&A

Q: How do I lose my love handles and get that lean, ripped-waisted look?

A: Most people make drastic cuts in their calorie intake when they're motivated to lose weight, and they lose lots of muscle. They also have no energy and eventually go on an eating binge because their cravings careen out of control due to the starvation mechanism. Here are the things you need to do to lose fat while maintaining muscle:

1) Gradually cut your calories. Each week reduce your daily intake by 50 to 100. That should prevent the starvation mechanism from kicking in and help you preserve muscle.

2) Don't eat the same thing every day. Slight calorie fluctuations will also help keep the starvation mechanism at bay.

3) Don't reduce your daily calories below 2,200. Eating less than that can reduce your nutrient intake to levels that are too severe for a healthy body.

4) If you need to get leaner after you've been holding your daily calories at 2,200 for a few weeks, gradually ramp up your activity. Fast walking is probably the best fat burner around. If you do it on an empty stomach—say, first thing in the morning—it's even better. No matter when you do your aerobic exercise, always try to fast for a few hours beforehand. That will force your body to use fat for fuel rather than the glucose circulating in your bloodstream.

5) Weight train five to seven days a week. The more often you jolt your metabolism with weight training, the more fat you'll lose. Remember, muscle tissue is the true fat incinerator.

6) You have to eat small, balanced meals and eat them often. Eating five to six times a day is perfect. See the back of this book for a complete diet.

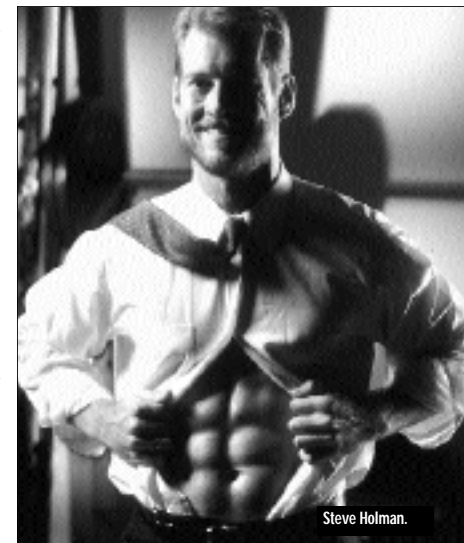
7) Strive to eat balanced meals at most of your feedings—45 percent carbs, 30 percent protein and 25 percent fat. Lean more toward protein, especially as the day wears on, as it will help spare muscle tissue. Carbs eaten at night tend to favor fat deposition, so cut carbs in the late afternoon and evening.

8) Never eat carbs alone, and always look for low-glycemic carbs—the ones that don't shoot up your insulin levels, which can cause more fat deposition.

9) Try not to eat anything after 7 p.m.

10) Use a couple of good fat-burning supplements, such as Syntrex Innovations' Adipokinetic and Muscle-Link's Thyro Stak. If you can't afford one of those, try two cups of coffee before you train. The caffeine will step up the fat burning.

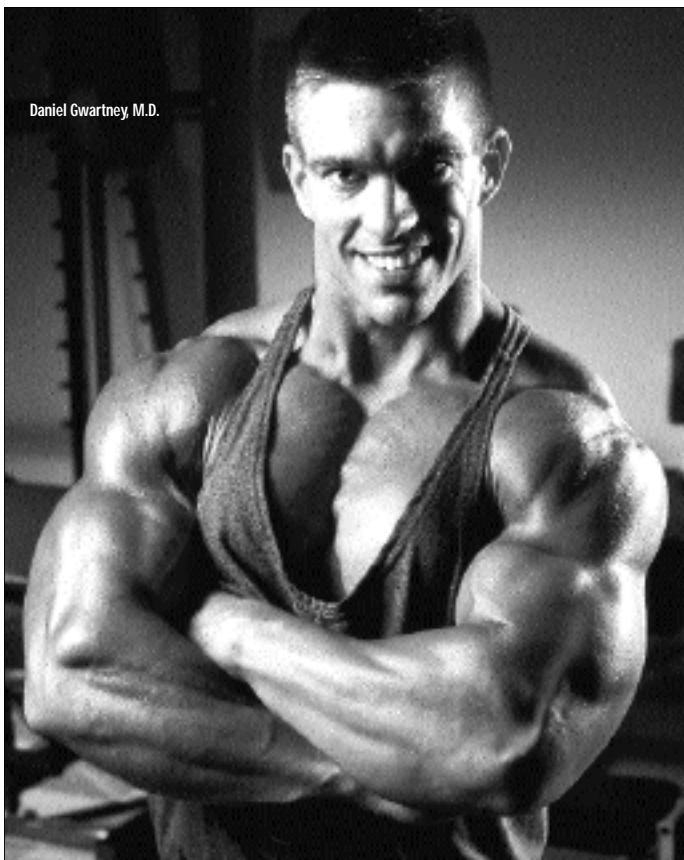
—Steve Holman, editor in chief, IRONMAN



Q: I've ordered Muscle-Link's Thyro Stak. How exactly do I use it?

A: Thyro Stak, which is essentially a blend of guggulsterones and phosphates along with other supporting nutrients, is designed to help maintain a normal thyroid function in conditions that would otherwise

Guggulsterones have been shown to stimulate the thyroid gland to release thyroid hormone. Phosphates have been shown to increase the rate of conversion of the low-activity thyroid hormone, T4, to the higher-activity T3.



cause a decrease in thyroid activity. Thyro Stak, unlike the pharmaceutical preparations Synthroid and Cytomel, is not a source of active thyroid hormone. That's an important distinction. Thyro Stak will allow your body to maintain a degree of regulation, rather than subjecting it to whatever dose people assault their bodies with in an attempt to meet weight-loss or bodyshaping goals.

Guggulsterones have been shown to stimulate the thyroid gland to release thyroid hormone. Phosphates have been shown to increase the rate of conversion of the low-activity thyroid hormone, T4, to the higher-activity T3. If you have a normal thyroid function, your body keeps your thyroid at a normal level when it's in a well-fed and rested state. When you subject yourself to stress, thyroid function and activity drop, giving you that sluggish state in which you have no energy, and fat loss grinds to a standstill. That stress may come from dropping calories below maintenance, dropping carbs, using stimulants, lacking sleep, mental stress, etc.

You have to combine Thyro Stak with some effort to get the results. If you're consuming 3,000 calories a day or hundreds of grams of carbs, Thyro Stak may not make a difference, as your body is not stressed. It needs to recognize a low-energy state that will cause it to lower the activity of the thyroid before the "normalizing" action of Thyro Stak will take effect. I wish I could offer you a magic pill. It would make me millions, as few people want to put forth any honest effort. For those of you who do, Thyro Stak will help you keep the fires burning, even when you're pushing yourself to the max.

I recommend you keep your calories at near maintenance, give or take a couple hundred, exercise vigorously and push the water for eight weeks. By then your body will probably have adapted by shutting down your thyroid activity. That will happen faster if you're not sleeping well or you use a stimulant for weight loss like the ephedrine-caffeine-and-aspirin stacks or Adipokinetix. You don't need to stop using those when you start using Thyro Stak, however, although you should watch your dose response because you may become resensitized to the stimulant properties of those products. Increasing the dose of Thyro Stak will not provide any additional benefits. Unless you want to resort to pharmaceuticals, which I don't recommend, you have to give your programs a little time and a lot of effort.

I don't recommend the ECA stacks because of the possibility for adverse reactions; however, since they facilitate fat loss by increasing the metabolism and working directly on the fat cells, users of both Thyro Stak and ECAs will probably see greater results.

—Daniel Gwartney, M.D.

Q: Do branched-chain amino acids burn fat?

A: The branched-chain amino acids (BCAAs) include leucine, isoleucine and valine, and they are so named because of their chemical structures. The recommended dietary allowance for BCAAs amounts to about three grams a day, but that doesn't take into account people who regularly engage in intense exercise.

BCAAs have several unique properties that other amino acids don't have. For example, while most amino acids are metabolized in the liver, BCAAs can bypass liver metabolism and go directly into muscle, where they serve as nitrogen donors for the synthesis of other vital amino acids, such as glutamine and alanine. In doing so, they exert an anticatabolic action in muscle.

BCAAs may also aid muscular endurance by opposing the entrance of free tryptophan into the brain. Tryptophan, like the BCAAs, is an essential amino acid; however, in the late stages of exercise, when BCAAs begin to be used as a fuel substrate, more tryptophan enters the brain, where it's rapidly converted into serotonin, a brain neurotransmitter that imparts a feeling of fatigue. Since BCAAs block the entrance of tryptophan into the brain, the theory is that taking them before extended exercise sessions will prevent premature fatigue.

While most amino acids are metabolized in the liver, BCAAs can bypass liver metabolism and go directly into muscle, where they serve as nitrogen donors for the synthesis of other vital amino acids. In doing so, they exert an anticatabolic action in muscle.



***Essential Fatty
Acids: Good Fat for
Health, Muscle
& Strength***

6



Essential Fatty Acids

by Rehan Jalali

Let me be up front about this: I'm going to try to make you buy something here. It's something that's good for you—and for your athletic performance—although it's an idea that takes getting used to. After all, nutritionists and diet gurus have been indoctrinating us about the evils of dietary fat since the 1970s, so it's difficult to believe that some fats are essential for life.

Apparently, the term *fat* is far too simple for the complex substance it represents. Here's why I believe it's in the best interest of everyone—bodybuilders and other athletes as well as everyday folks—to consider supplementing essential fats.

There are two essential fatty acids, or EFAs, linoleic acid and linolenic acid. Linoleic acid is included in the category known as omega-6 fatty acids, while linolenic acid—specifically, alpha linolenic acid—is an omega-3 fatty acid. Another omega-6 fatty acid, gamma linoleic acid (GLA), is also important for health and athletic performance. Like water and vitamins and certain amino acids, linoleic and alpha linolenic acids are required for life. If you don't get them from your diet, your body will deteriorate and you'll die.

Granted, a minimal level is required to stave off the ravages of deficiency. It hasn't been clearly defined, however, and there is no USRDA (United States recommended daily allowance) for either essential fatty acid. In the book *Fats That Heal, Fats That Kill* (Alive Books, 1997), author Udo Erasmus suggests a minimum daily intake of three to six grams of linoleic acid and one to three grams of linolenic acid to prevent deficiency. He further suggests that for optimum health people should take in 3 to 6 percent of their calories as linoleic acid and 2 percent as linolenic acid. (If you're truly interested in fats and their effects on health, I strongly recommend this book.)

There's a class of "hormones" called

prostaglandins in the human body. Certain prostaglandins are beneficial for health and disease prevention, while others are essential to the body's reaction to stress or injury. Prostaglandins are derived from essential fatty acids. There are three classes, or series, of prostaglandins. The series 1 versions, particularly PGE1, have many beneficial effects for athletes. They appear to have anabolic effects, promote thermogenesis, increase sodium and water clearance by the kidneys and prevent blood clots. Series 2 prostaglandins have the opposite effects, as they seem to trigger the release of energy substrates by breaking down structural protein, causing salt and water retention and promoting the clotting of blood. Nature always maintains a balance. In a fight-or-flight situation your body reacts to ensure your short-term survival: Your blood pressure becomes elevated, the bleeding stops and the energy the body needs becomes available.

One interesting fact is that both series 1 and series 2 prostaglandins are derived from the same precursor, linoleic acid (omega-6 fatty acid), while series 3 prostaglandins are derived from linolenic acid (omega-3 fatty acid). The series 3 prostaglandins are important not for their actions but, rather, for their ability to decrease the rate at which series 2 prostaglandins are formed.

So series 1 prostaglandins promote performance, series 2 prostaglandins disrupt performance, and series 3 prostaglandins block the formation of series 2 prostaglandins. Obviously, you'd just want to buy series 1 and series 3 prostaglandins. How wonderful if it were that easy. Unfortunately, it's not. You'll probably get a direct-mail offer to purchase East German series 1 and series 3 prostaglandins sometime soon. Don't believe it.

Prostaglandins are not true hormones. They're paracrine hormones or in some cases autocrine hormones, which means they're only active in or near the cell where they're generated. True hormones float all through the body to reach distant target organs or tissues. The downside to the

Nature created a balance for a reason, and you should maintain it. Over the long term you should take in dietary fatty acids in a ratio that supports nature's balance, and the product that will do that is hemp seed oil.

local-action-only feature is that prostaglandins aren't orally bioavailable—unless you take them in huge amounts—and can only be administered intravenously. The upside is that you can take the precursors—the essential fatty acids—and give your body the building blocks to form prostaglandins naturally and legally.

That brings me to a superior source of essential fats, Omega Stak™. To begin with, it's a nitrogen-flushed product in gelcap form.

Essential fatty acids have specific chemical structures, including fragile double bonds that are easily disturbed by heat, pressure and even light. Oils that contain essential fatty acids are basically liquid fatty acids and must be protected from heat, pressure and light throughout the pressing, packaging and shipping processes. What's more, manufacturers must remove any extra oxygen from the processing lines and from inside the bottle, which is usually done by flushing the lines and bottle with nitrogen gas. To that end, gelcaps are less air sensitive and may have more stability.

Of course, a quality process is meaningless unless it makes a quality product, and Omega Stak contains the cold-pressed oil of organic soybeans, flax seeds, borage seed and wheat germ. It also contains lecithin, rosemary oil and vitamins E and C. Many of us have used flaxseed oil or evening primrose oil for fat supplementation. Flaxseed provides a high concentration of omega-3 fatty acids, while evening primrose is a good source of GLA. Although they're fine for correcting a deficiency or imbalance of omega-3 or omega-6, respectively, Omega Stak is more balanced, with a number of oils that provide the essential fats in a perfect balance. Nature created a balance for a reason, and you should maintain it.

The days of water-packed tuna and rice are over as fats become a key player in bodybuilding-diet strategy. Omega Stak can help you get the most health and performance benefits the EFAs have to offer.

Editor's note: Rehan Jalali is the president of the Supplement Research Foundation. He has a B.S. in nutrition and biochemistry and has studied the science of nutrition and supplementation for the past seven years. He's also a nationally ranked competitive natural bodybuilder and former collegiate powerlifter.

Essential Fats Q&A



Q: *What's the deal with fat? I thought it was bad, but now I keep reading about how I need it.*

A: Too much saturated fat can be bad for you in that it can contribute to heart disease, but the fats known as essential fatty acids, or EFAs, are absolutely necessary for optimal health. EFAs can prevent heart disease, and they can enhance your ability to build muscle and even burn fat.

Studies have shown that EFAs can do everything from improving the action of insulin to decreasing muscle breakdown to increasing hormone production, specifically growth hormone and testosterone. They do it through a number of mechanisms, one of which is helping the body manufacture prostaglandins.

Where do you get EFAs? Nuts, seeds, fish and various oils can provide a lot of them, and even animal fats have some as well, but animal fats also contain loads of saturated fat, so don't overdo the steak and pork chops.

Science has recently discovered that the EFAs, including the omega-3s, -6s and -9s, are vital for health. You may have noticed that nuts are included in many diets in *IRONMAN*, precisely because they contain the EFAs that facilitate proper hormone production. For most bodybuilders, however, a balanced EFA supplement is also necessary for an optimal muscle-building environment, especially those who are restricting calories to stay lean.

—Steve Holman, editor in chief, *IRONMAN*

Q: *There's a lot of new research on the essential fatty acids—for example, indicating that they help build muscle and burn bodyfat. Would you elaborate on those points?*

A: I agree with those who say that relative deficiencies of essential fatty acids—particularly omega-3 fatty acids—are becoming increasingly evident. Much of this derives from the fear of fat that's instilled by well-meaning but ill-informed “experts” who fail to differentiate good fats from bad fats. An example of bad fats would be trans fats, which are ubiquitous in our food yet have no value other than maintaining shelf life.

Among the benefits associated with fats such as omega-3s are increased insulin sensitivity even when people are on a high-fat diet, which normally promotes decreased insulin sensitivity. The increased insulin response favors lower bodyfat. Omega-3 fats also promote a tighter binding of IGF-1 to cell receptors, which favors an anabolic muscle effect. In addition, omega-3 fats comprise much of the fat found in the brain, and emerging theories show that a long-standing omega-3 deficiency may lead to depression. A recent study reported in *Biological Psychiatry* found that depressed people had brain levels of omega-3s that were 40 percent lower than normal.

You may, however, want to avoid consuming an omega-3 source, such as fish or flaxseed oil, just before you go to bed. At least two substances known to induce sleep, interleukin-1 and prostaglandin D2, are inhibited by omega-3 fats, although they are stimulated by the omega-6 fats found in vegetable oils; i.e., linoleic acid.

Other studies show that a diet containing at least 30 percent fat is absolutely essential to testosterone synthesis in the body. This is particularly important for natural bodybuilders, who often favor diets of less than 10 percent total fat. Such diets, when combined with the increased cortisol release that oc-

Omega-3 fats also promote a tighter binding of IGF-1 to cell receptors, which favors an anabolic muscle effect.

ctors with extensive aerobic training, are a good way to induce a high level of muscle catabolism.

I think the emphasis should be on omega-3s and omega-9s, with a smaller intake of omega-6 fats. You do need some linoleic acid, since it can't be synthesized in the body. Anyone who uses a supplement such as flaxseed oil or borage oil, however, is well covered in this area.

—Jerry Brainum, *bodybuilding and nutrition researcher*

Q: I want your recommendation for the most anabolic legal supplement I can use—cost is no object.

A: Specific dietary fats. I know that isn't the answer you wanted. I imagine you were hoping that one of the exotic supersoluble pro-hormone gargling mouthwashes or the new spit-back-at-you creatines would be my anabolic top choice, but it's time to start thinking of fat as a supplement. Fat: disgusting, boring fat!

About three years ago a number of bodybuilding writers including Will Brink and myself proposed the idea of increasing performance by modifying an athlete's diet with more specific dietary fats, especially essential and monounsaturated fatty acids. Most of those new, lower-carbohydrate eating regimens were geared toward fat loss, and



they're still popular. I've noticed, however, that bodybuilders who want to gain muscle seem to avoid my original advice: To grow muscle, eat more dietary fat, not only on a low-calorie program but even at above-maintenance calories! A typical plateaued "I can't gain weight" bodybuilder, who was eating 4,000 calories a day in protein and carbs, actually lowered the number of calories he'd been eating and gained muscle, not fat, by eating less protein and eating fat!

How was it possible? His body was oxidizing a portion of the protein he was eating into glucose for energy. He wasn't getting fat, but his body had reduced his protein synthesis to make the conversion of protein to glucose more efficient. An anabolic environment in the body is a state in which the correct selection of macronutrients causes growth. Having an anabolic environment doesn't mean eating as many calories as possible and not getting fat. If all it took to build muscle was to drink a protein drink three times a day, we'd all be huge by now.

John Parrillo has always advocated increasing fats, but his choice has been the esoteric medium-chain triglyceride oil (MCT), the "fat-less" fat. How did John convince his clients and customers to consume those dreaded fat calories? He packaged the oil and directed its use as if it were a supplement, not a simple macronutrient. Supplements seem so precise, high-tech, even...druglike. So I use John's trick to make fats more morally acceptable. We no longer eat "fat." We now take our dose of fatty acids.

Suppose I want to recommend some essential fatty acids. I never say, "Eat some salmon or trout every day." I say, "Take six grams of fish oil capsules, two capsules three times a day." Or I say, "You must add one tablespoon of flaxseed oil to every blender drink." My ideal choice for dietary fat would be whole-food sources, like fish, nuts, avocados or olives, as their various trace micronutrients have added benefit; however, I accept the fact that while bodybuilders won't eat fatty foods, they will consume fat "supplements." Most bodybuilders treat fat as a micronutrient, taking in only milligrams a day, not as a major source of energy calories. Yes, you can consume the bare minimum of essential fatty acids in capsule form, whether it be fish oils or the more exotic hemp-seed oils, but a few capsules won't add enough calories to tip the anabolic balance in your favor. You need to have at least 20 percent of your daily calories coming from fats to improve protein synthesis. Remember, there's no research showing that adding pro-hormones will improve protein synthesis, but there is such research on dietary fats.

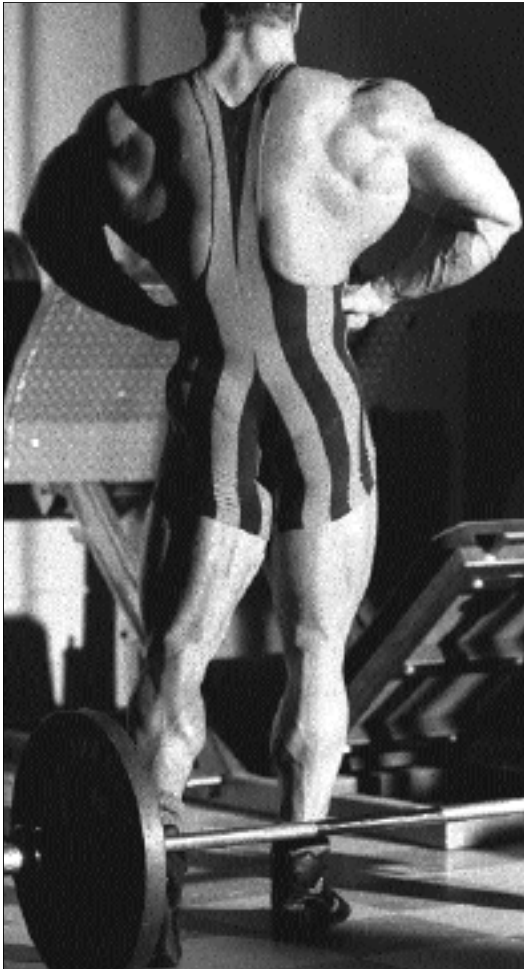
To make it easy, I like to recommend splitting your fats into thirds: Of your minimum 20 percent fat calories, about 7 percent should come from saturated fats (all meat, dairy and MCT fats qualify), another 7 percent from essential fatty acids (from vegetable oil sources) and the last 7 percent from monounsaturated fats found in olive oil and macadamia nut oil.

You need to have at least 20 percent of your daily calories coming from fats to improve protein synthesis. Remember, there's no research showing that adding pro-hormones will improve protein synthesis, but there is such research on dietary fats.

Eat three solid-food meals. Drink three blender protein drinks, and in each one include one tablespoon of MCT oil and one tablespoon of flaxseed oil or use oil capsules.

My top anabolic choice: 20 to 30 percent of your calories coming from dietary fats every day. Eat three solid-food meals. Drink three blender protein drinks, and in each one include one tablespoon of MCT oil and one tablespoon of flaxseed oil or use oil capsules. Make sure you use two tablespoons of olive oil on your salad greens. If you can't stand olive oil (I can't), use macadamia nuts or their oil. And take six fish oil capsules a day. If you do that every day, you'll be getting at least 20 percent of your calories from dietary fats. Your body will improve protein synthesis, and less of the protein you consume will be oxidized as an energy source.

—Dan Duchaine,
author, *Body Opus*





***Anabolic and
Anticatabolic
Nutrients***

7



Glutamine: The Essential Nonessential Amino Acid, Part 1

by Michael Gündill

Bodybuilders know about the importance of proteins. Yet it seems that some amino acids are more important than others in the muscle-building process. Glutamine has earned a reputation as king of the anabolic aminos—but is it justified? What's the big deal about glutamine, and how can you use it to your advantage?

Why Does Glutamine Stand Out?

Glutamine's importance is both quantitative and qualitative. Two-thirds of the free amino acids inside your muscles is glutamine. Muscles are not only a reservoir but also a major manufacturer. Most of the glutamine in your bloodstream is made in the muscles and organs, such as the liver. You can't get it directly from your meals, as it's digested and altered in the intestine. Many of the other amino acids, especially the branched-chain aminos (BCCAs), serve as precursors in glutamine synthesis.

Qualitatively, glutamine has a unique role in the muscle-building process. In the mid-'80s researchers discovered a very close relationship between free intramuscular glutamine levels and the protein synthesis rate. The higher the level of free glutamine inside your muscle, the faster the muscle grows. What's still unclear is whether the phenomenon is a cause or a consequence of anabolism: Is muscle growth accelerated because glutamine is high, or is glutamine upregulated to serve as raw material to support fast growth?

A popular hypothesis about the relationship between glutamine and growth is the muscle-swelling theory. Muscle anabolism can be accelerated by the swelling of the cells, which means water, ions and amino acids suddenly entering the cell, causing it to expand. The state of cellular hydration is supposed to influence its growth rate. The greater the hydration, the higher the protein synthesis rate. Cell

shrinkage, on the other hand, is supposed to favor catabolism.

The relationship exists only if the swelling is not caused by cellular damage or trauma. Research has shown that the entry of glutamine into the muscle cell can increase its volume, inducing growth,¹ but cellular swelling can also accelerate the entry of glutamine into the muscle—which leaves us with the debate about whether it's the cause or the consequence.

Here are two key points to remember about glutamine:

- Glutamine makes up two-thirds of the muscle's free amino acid content.
- You should keep muscle glutamine as high as possible because it either induces or supports growth.

Integrins: The Mechanosensitive Molecules

A mechanosensitive molecule senses how much tension is applied to muscle cells in order to modulate their growth rate. If you remain inactive, lying in bed for days, your muscle mass shrinks because of a lack of tension. As you train, the muscle contractions cause a great strain on the cellular membranes, triggering growth. It's a fascinating process, one in which integrins are believed to play an important part.

Integrins are thought to be mechanosensors. They are chains that are hooked up to both the muscle cells and the extracellular matrix; that is, the very tough structure that holds all the muscle cells together. When a muscle cell is either flexed or swollen, great pressures are applied to the integrins, as they're forced to prevent the whole structure from bursting. In addition to their structural role, however, they're also regulatory receptors. In other words, integrins transduce, or convert, training-induced tension into chemical signals that re-

Glutamine makes up two-thirds of the muscle's free amino acid content, and you should keep muscle glutamine as high as possible because it either induces or supports growth.

sult in muscle growth.

It's interesting to note that whenever integrin functions are blocked, cell swelling cannot stimulate glutamine transport.² That points up the importance of integrins' role in the growth process whenever mechanical forces—like weight training—are the main stimulator. It also links glutamine not only to growth but also to the transduction of training-induced tension into anabolism. So, in theory at least, glutamine may be far more important for bodybuilders than was previously thought.

Is Glutamine Truly Anabolic?

It would be too easy if researchers could agree on the mechanisms by which glutamine is linked to growth. Some claim it's both anabolic and anticatabolic, while others can detect only an anabolic or a protective influence.

Darmaun and co-workers at a research center in Florida gave glutamine intravenously to healthy adults, and the results showed that anabolism was increased with no effect on catabolism.³ Recently, he reported an experiment that's even more relevant for bodybuilders.⁴ He used a chemical named phenylbutyrate to deplete glutamine in the blood by 26 percent, which translated into an estimated 11 percent decrease in the protein synthesis rate. No obvious change in catabolism was detected. Please keep those two figures in mind as you read the following.

Another group of scientists managed to increase the intramuscular content of glutamine in men, which resulted in an increased muscle protein synthesis. Those findings tend to show that glutamine is a direct growth mediator—although they could also mean that the anabolic drive is restricted because a relative shortage of glutamine represents a bottleneck.

Is Glutamine Anticatabolic at All?

According to the studies mentioned above, glutamine doesn't have much impact on catabolism; however, other researchers did detect that effect. Two factors are usually suspected of causing the discrepancies. One is the way in which protein turnover is measured. The other is the methodology used, meaning the time of day, method of glutamine administration, doses, subjects, etc. An experiment by Perriello, et al., in which fasting subjects were given glutamine intravenously, showed that above all, glutamine reduced catabolism.⁵ The lesson for bodybuilders is that when you fast (at night, for example), the relative shortage of glutamine supply will increase muscle loss.

Here are two more points to remember:

- Glutamine is either anabolic or else a shortage of it impairs anabolism.
- Adequate glutamine supply may prevent catabolism.

Training-Induced Glutamine Deficit

Growing bodybuilders slowly build up their muscle glutamine stores, which can hide wide and dangerous short-term fluctuations. Each time you train, you deplete your glutamine reserves for several hours. That's a very unfortunate consequence of training, and you have to combat it.

Glutamine depletion follows a strange biphasic course. The first drop is the blood glutamine, and it occurs early in the workout. To make up for the deficit, your muscle starts manufacturing new glutamine from other amino acids, such as the BCAAs. That leads to the depletion of the other anabolic aminos. Eventually, the newly manufactured glutamine passes into the blood, which creates a shortage of muscle glutamine. If the glutamine manufacture is quick enough to compensate for the wasting of circulating glutamine, blood fluctuations may go undetected.⁶ If the wasting is considerably stronger than the muscle manufacture, as frequently occurs during weight training, the drop in blood glutamine will be readily apparent. Australian researcher D. Keast detected a drop of 55 percent in blood glutamine immediately after a very intense interval workout.⁷ He demonstrated that muscle glutamine synthesis capacities can be greatly overwhelmed during and immediately after intense training.

Even more worrisome is the fact that the effect is very long lasting. In studies conducted at the University of Birmingham, England, Walsh and co-workers were not able to detect any fall in blood glutamine immediately after exercise, probably because they used a slightly lower training intensity than Keast.⁶

That means the muscle manufacturing capacities were able to keep up with the blood glutamine wasting for a while. Unlike Keast, who did a single post-training analysis, however, Walsh kept repeating his glutamine measures. He discovered that blood glutamine was 16 percent below normal five hours after the workout. It would seem that glutamine wasting eventually overwhelms the manufacturing capacities, perhaps as wasting continues accelerating and/or the synthesis process is exhausted. So, if you train at 6 p.m. for two hours, at 1 a.m., while you're sleeping, all your glutamine stores will be depleted.

According to the phenylbutyrate study discussed above, a lasting shortage of glutamine causes the protein synthesis rate to be depressed for a long while after training if no specific measures are taken. Since the overnight fasting also causes glutamine depletion, the two wasting processes combine to exacerbate catabolism. Needless to say, if you retrain your muscles while glutamine stores are still low, you'll get yourself into serious trouble. Your muscle will never have a chance to recover, which will lead to chronic overtraining.

The key points to remember here are as follows:

- Weight training depletes glutamine stores.
- It's a very long-lasting depletion.
- It's likely to be even more pronounced if you train at night.

Australian researcher D. Keast detected a drop of 55 percent in blood glutamine immediately after a very intense interval workout. He demonstrated that muscle glutamine synthesis capacities can be greatly overwhelmed during and immediately after intense training.

Another probable cause of the long-term depletion of blood glutamine is the activation of the immune system by training. The immune cells use glutamine as fuel, which taxes the body reserves even further.

Why Is Glutamine Destroyed During a Workout?

Training enhances the body's glutamine use through four major pathways. Intense training tends to rapidly increase the output of cortisol, which is a major waster of glutamine. That instantaneously increases the intestine's need for glutamine, which accelerates the extraction of it from the blood. Cortisol promotes the degradation of glutamine in the liver, further depleting blood glutamine.

Training increases your body's consumption of carbs, so the blood levels of both glucose and insulin are likely to decline. That causes the internal manufacture of carbs from noncarbohydrate molecules through a process called gluconeogenesis. Both the liver and kidneys attract amino acids—chiefly as alanine and glutamine—to transform them into carbohydrates.

Another major function of blood glutamine is to maintain the acid/base equilibrium. As you weight train, your muscles produce lactic acid, which passes into the blood and acidifies it. You can tell when that happens because your muscles burn at the end of an intense set.

The kidneys detect a drop in blood pH, forcing them to attract blood glutamine at an increasing pace. The renal consumption of glutamine can be enormous, which indirectly increases the bicarbonate level. Once the newly manufactured bicarbonate reaches the blood, it serves as a buffer and so binds the blood acid to render it neutral. That causes the blood pH to increase and the acid/base balance to be restored.

Another probable cause of the long-term depletion of blood glu-

tamine is the activation of the immune system by training. The immune cells use glutamine as fuel, which taxes the body reserves even further.

The Case for Glutamine Supplementation

I hope I've given you a better understand of glutamine's role in your body. A key point is that training reduces both blood and muscle glutamine. While the muscles of some bodybuilders have sufficient glutamine to cover the immediate training-induced wasting, that's not the case for many. In a matter of a few hours they run short of glutamine because of the delayed actions of training, a shortage that's likely to occur in the middle of the night, when blood glutamine tends to be depressed for other reasons. So anabolism is reduced exactly when it's supposed to be boosted.

You may think that you can escape the problem by adding a few glutamine pills during the postworkout period. It's not that easy, though, and for two reasons: 1) Most of the oral glutamine doesn't make it to the blood, and 2) even if it does, it isn't likely to enter the muscle.

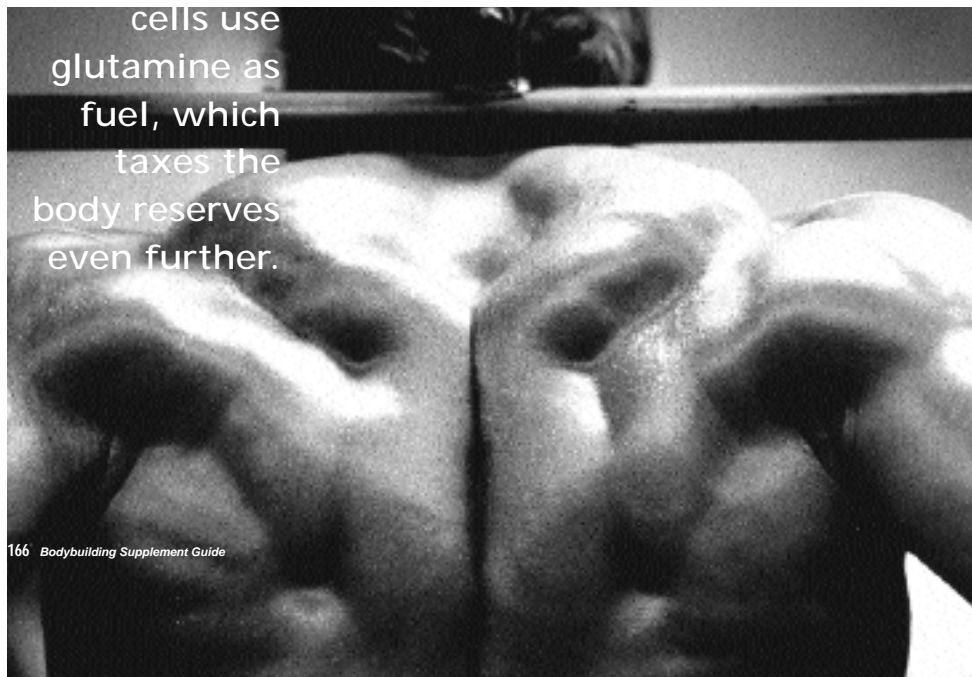
Your goal, therefore, is threefold: 1) minimize the wasting of glutamine during and after training, 2) compensate for the fall in glutamine stores and 3) find out if it's possible to load your muscles with glutamine as you do with creatine in order to upregulate anabolism.

Editor's note: Michael Gündill is a respected European researcher who specializes in physiology, endocrinology, pharmacology and nutrition. He has weight trained for more than 15 years.

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In a matter of a few hours bodybuilders run short of glutamine because of the delayed actions of training, a shortage that's likely to occur in the middle of the night, when blood glutamine tends to be depressed for other reasons. So anabolism is reduced exactly when it's supposed to be boosted.



Glutamine: The Essential Nonessential Amino Acid, Part 2

by Michael Gündill

The amino acid glutamine has a unique and key role in the muscle-building process. It's intimately linked to growth. The more glutamine your muscles contain, the more they'll grow. Therefore, you should attempt to load your muscles with glutamine. Unfortunately, that's easier said than done, and you face two major obstacles: 1) Intense training depletes glutamine stores, and 2) most of the glutamine you take in through food or supplements doesn't make it into the blood, much less to the muscle. The question, then, is, How do you force your muscles to accept glutamine when they refuse to let it in?

Weightlifting Wastes Glutamine Stores

Every time you train, you put a great strain on your glutamine reserves, with both blood and muscle glutamine becoming depleted. Muscles will respond by manufacturing new glutamine from other amino acids, especially the branched-chain amino acids (BCAAs); however, it's usually not sufficient to keep up with the accelerated glutamine wasting, and, of course, it also causes a shortage of BCAAs. As the body cannot synthesize BCAAs, you have to get them from food or supplements. Conversely, since they're glutamine precursors, taking supplemental BCAAs is a way to restore your body's glutamine reserves.

Training-induced glutamine wasting doesn't stop when your workout is over. It lasts a very long time and keeps accelerating in the postworkout period as your glutamine-manufacturing capacity becomes exhausted. It's up to you to provide enough glutamine or glutamine precursors to fill the gap between the depletion and the supply. Dietary amino acids alone won't be strong enough to fully ensure against a temporary glutamine shortage. You have to recruit the power of your endocrine

system to help in the glutamine manipulation.

What Happens to Dietary Glutamine

Most of the glutamine you take in through food doesn't survive to enter your blood. It does increase your blood glutamine level,¹ but between 60 and 80 percent of dietary glutamine is taken up by the intestine and never reaches the blood. The 20 to 40 percent that's left is handy to have, but it won't be enough to meet the postworkout demand.

Why Would Glutamine Enter the Muscle Anyway?

Even if you could find a way to increase the level of glutamine in your blood, the real goal is to load your muscles with it. Not only would it refill the glutamine reserves, but it would also stimulate or support extra muscle growth. In theory, it's possible to coax the blood glutamine into entering your muscles, but in practice things aren't that simple for bodybuilders. The surface of each muscle cell contains glutamine transporters, or pumps, which are small holes in the cell membrane that open up to act as a channel for glutamine. Like vacuum cleaners they can be turned on and turned off.

In theory, when muscle glutamine levels are low, the glutamine pumps are turned on, and when you have an excess of muscle glutamine, they're turned off. Obviously, the off state is a major obstacle to loading your muscles with glutamine. It's a problem similar to the creatine pumps that stop working whenever muscle creatine levels reach a critical threshold.

Although you might wish that in the post-training period the starving muscles would easily take up the dietary glutamine, it doesn't work that way. The glutamine transport from the blood to the muscle is said to be sodium dependent, which means

that the muscle takes up the glutamine and some sodium. Once they're inside the cell, the glutamine is held back while the salt is pushed out. Even so—and despite what you may hear via the bodybuilding grapevine—eating extra salt won't help you with glutamine manipulation unless you're taking powerful diuretics.

The elegantly designed machinery works well unless the newly arrived salt isn't leaving the cell fast enough to match the rate of sodium entry. If the pumps that are forcing the salt out of the cell are overwhelmed, the ones that are pumping the extracellular salt into the muscle stop working, and when they stop bringing salt into the cell, they also stop pumping in glutamine.

There are several reasons why glutamine entry into the muscle is blocked after a workout. For one thing, high cortisol levels will impair it. For another, the muscle cells are already loaded with sodium. As a general rule, whenever there's an excess of sodium in the muscle, a wasting process is at work.

The unwanted invasion of sodium is due to several causes. During training muscle burn stimulates the entry of sodium in exchange for the acid responsible for the burning sensation. After training the wear and tear inflicted on the muscle cells precipitates the leak of blood sodium into the muscle. Although glutamine entry is sodium dependent, sodium doesn't necessarily bring glutamine along with it when it enters the muscle cell. In other words, sodium entry is not dependent on glutamine. While sodium can freely leak into the muscle, the process by

There are several reasons why glutamine entry into the muscle is blocked after a workout. For one thing, high cortisol levels will impair it.



When cortisol is high, all glutamine stores become depleted. It's important to keep your cortisol level under close scrutiny, as there's no way a dietary intake of amino acids or glutamine can counter its powerful negative influence.

which it is pumped out of the cell is energy, or ATP, dependent.

Unfortunately, ATP levels are reduced in the postworkout period, so the pump can't eliminate the sodium as fast as is required. The sodium loading ultimately translates into the slight muscle swelling that's apparent in the few days following a workout. It means that muscle glutamine entry is impaired—or at least slowed—not only during the workout but also for a long time afterward. That contrasts with the glutamine wasting, which is high during the same period.

Cortisol: Glutamine's Most Dangerous Enemy

Although a normal basal cortisol level can participate in muscle growth, an excess impairs the process. Intense training tends to bring you closer to that dangerous threshold. When cortisol is high, all glutamine stores become depleted. Cortisol forces your intestine and liver to increase their glutamine consumption, and it works with glucagon in the liver to destroy the glutamine. On top of that, cortisol favors sodium accumulation in the muscle, which may explain in part why cortisol severely impairs glutamine entry into the muscles while accelerating its exit. The result is a depletion of muscle glutamine in addition to the depletion caused by training. Consequently, it's important to keep your cortisol level under close scrutiny, as there's no way a dietary intake of amino acids or glutamine can counter its powerful negative influence.

Insulin Transports Glutamine

If some hormones cause glutamine depletion, others have the opposite effect. Insulin is your first ally in glutamine manipulation. Glutamine is one of the few amino acids whose entry into the muscle can be enhanced by insulin, and you can certainly see the advantage of that. Any attempt to load up on glutamine should take advantage of the insulin-booster effect.

Some of the favorable actions of insulin are brought about by its influence on sodium. Insulin helps your muscles get rid of the extra sodium, which is a very interesting property in light of the sodium invasion that follows training. What's more, the anabolic effects of insulin and glutamine reinforce each other and can only be maximum when both are present.

The Mighty GH

Growth hormone (GH) was made to work along with glutamine, and vice versa. Bodybuilders have long been aware of the close relationship between the two because of the fact that oral glutamine can increase GH.¹ On the other hand, they may not be aware that GH also increases glutamine levels in both blood and muscles without the ne-

cessity of any particular dietary change. Therefore, GH is truly the mighty ally you're looking for in glutamine manipulation.

One of the ways GH works is to limit the wasting of glutamine in the liver, where it can be transformed into urea. The urea is ultimately excreted in the urine, which means the glutamine is wasted simply because there's a catabolic process at work. Research has shown that GH shunts the "extracted glutamine nitrogen from urea via hepatic glutamate release."³ The newly formed glutamate can be transformed into glutamine in the muscle. So, instead of allowing glutamine to be urinated as a waste product, GH favors the recycling of it.

GH also has another major preserving effect on glutamine in the kidneys. As discussed in Part 1 of this series, one of the reasons glutamine degradation is accelerated after training is that lactic acid accumulates in the blood. That lowers plasma pH and forces the kidneys to extract circulating glutamine at a very fast pace. GH helps your kidneys to get rid of the acid load and as a result reduces their need for glutamine.⁴ Oral glutamine synergizes with GH at that point, not only by increasing the GH level but also by helping the hormone get rid of the acid that's generated by training.¹ Other favorable effects of GH on glutamine are brought about indirectly by the elevation of insulinlike growth factor (IGF-1), a peptide that shares many of the positive actions of insulin on glutamine.

Testosterone Boosters to the Rescue

Research has shown that an elevation of androgen spares muscle glutamine content in catabolic situations. While part of that action of testosterone is likely to be direct, androgen precursors will synergize with many of the hormones discussed above as well. A good GH booster will work well with testosterone. Phosphatidylserine and vitamin C, which help control the secretion of cortisol, will synergize with the hormones to prevent the glutamine-wasting actions of corticoids.

Techniques for Glutamine Manipulation

Effective glutamine manipulation will include three distinct steps:

- 1) Reduce the training-induced glutamine wasting.
- 2) Refill the glutamine stores to prevent a shortage of glutamine.
- 3) Attempt glutamine loading.

The first two steps are meant to combat some of the catabolic effects of training and enhance recovery. The third step is more aggressive, as it attempts to boost anabolism through dietary and endocrine manipulation rather than training. In fact, it tries to duplicate what you're already doing with creatine.

Here's a rundown of how to take those steps.

- 1) Reduce the training-induced glutamine wasting. At this point your best ally is the carb drinks. Blood glucose levels tend to fall during

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Drinking a casein drink or a casein-and-whey formula before a workout ensures the slow but long-lasting release of both glutamine and BCAAs while you train. If you can afford a glutamine supplement, use it before, rather than during, your workout.

training. As a result, insulin secretion is repressed while the secretions of cortisol and glucagon are enhanced. You want to reverse the situation, which is easily accomplished by increasing your carb intake before your workout and using a carb drink through the session. Studies have shown that carb drinks boost glutamine output at the end of a workout by cleaning out many of the waste products that accumulate in the muscles during exercise. That's a double advantage you shouldn't neglect. A preworkout stack of both GH and testosterone boosters along with phosphatidylserine and vitamin C will enable you to go beyond what you can achieve with a simple dietary manipulation.

2) Refill the glutamine stores to prevent a shortage. The proteins derived from casein are usually the richest in glutamine; however, many manufacturers of whey supplements add extra glutamine to their proteins to make up for the comparative disadvantage. Drinking a casein drink or a casein-and-whey formula before a workout ensures the slow but long-lasting release of both glutamine and BCAAs while you train. If you can afford a glutamine supplement, use it before, rather than during, your workout. If you're on a tight budget, though, skip the glutamine at this point in your supplement schedule. Oral BCAAs are cheaper and more appropriate to the situation. As glutamine precursors, they're rapidly transformed into glutamine in the muscles. BCAAs have the advantage of building up the glutamine stores while bypassing the intestine barrier and the problem of getting into the muscle.²

Once your workout is over, have a shake made of fast-acting whey protein instead of going home with an empty stomach. If your whey is reinforced with glutamine, it's not crucial that you also take glutamine pills at this point either. The protein drink will combat the short-term post-training glutamine depression.⁶ I like to add creatine in order to help refill muscle ATP, which will be essential for the transport of muscle glutamine.

You should eat a normal meal 30 to 45 minutes after your post-training protein drink. If you train in the morning, you can have a meal rich in both proteins and carbs. If you train at night, you want to be very careful about your carb intake at that hour if you want to remain reasonably lean. That's where glutamine pills can come in handy. To help your body fight the training-induced long-term wasting, take two grams of glutamine every hour for four hours—and skip the BCAAs, as they're said to compete with glutamine for entry into the muscle. You can help accelerate the entry of glutamine into the muscle by also using compounds that help accelerate the pumping of sodium out of the cell. Insulin release after carb intake is one.

3) Attempt glutamine loading. This may well be the most controversial aspect of the process. Is it possible to load your muscles with glutamine to force them to grow? Most specialists would agree that it's very hard to boost glutamine beyond normal levels in the muscles. A simple dietary ingestion of it is bound to produce limited results because of the absorption and muscle-entry problems. The experts usually

recommend very high doses of glutamine to bypass those problems. The high doses reflect the limitations of our knowledge about the amino. The powerful effects of GH demonstrate that relatively small doses of glutamine can boost muscle glutamine considerably. Until science provides us with more appropriate tools for delivery, however, taking high doses of at least 15 grams a day is the only way to go.

In a very recent study researchers were able to load subjects' muscles with glutamine without increasing glutamine doses. Instead, they used a very interesting compound called dichloroacetate (DCA).⁷ Under various conditions DCA can increase muscle performance in humans. It did increase muscle glutamine levels rapidly. That's the good news. The bad news is that it was used on burn patients and failed to increase protein synthesis. Nevertheless, it is certainly a very promising compound for bodybuilders.

Here are some key points about glutamine to remember:

- GH is of utmost importance for preserving glutamine and loading the muscles with it.
- Insulin accelerates glutamine transport, which is usually a rate-limiting step.
- You must keep cortisol levels under control, or your dietary glutamine will all be wasted.

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•GH is of utmost importance for preserving glutamine and loading the muscles with it.
•Insulin accelerates glutamine transport, which is usually a rate-limiting step.
•You must keep cortisol levels under control, or your dietary glutamine will all be wasted.

Hormonal Wars: The Conflict From Within

by Jerry Brainum

While you may not be aware of it, a struggle for biochemical domination is occurring within you. The victor of this war ultimately determines whether you make muscular gains or lose muscle and even get fat. The two combating armies are collectively called anabolic and catabolic hormones. The most familiar of them from a bodybuilding perspective are testosterone (anabolic), growth hormone (anabolic), insulin (anabolic) and cortisol (catabolic).

Anabolic refers to the metabolic building processes. The actions of anabolic hormones involve either an increase in muscle protein synthesis or a decreased breakdown of muscle protein. Increased breakdown of muscle is the chief characteristic of catabolic reactions. You would think that since cortisol, the body's primary catabolic hormone, is so outnumbered by the anabolic forces, it would be more or less an ineffectual player in the hormonal battle between anabolic and catabolic reactions, but that isn't the case.

Since cortisol, a product of the adrenal gland cortex, is a primary stress hormone, it's activated by any type of stress the higher brain centers that govern its release perceive. Since stress is ubiquitous, the body is constantly secreting cortisol, with peaks in the early morning hours and a low during the initial stages of deep sleep.

While cortisol has gotten a bad reputation among bodybuilders due to its potent catabolic activity and tendency to promote bodyfat accretion, the fact remains that it's also essential to life. During stress reactions it's the first line of defense in, among other functions, maintaining energy levels and blood pressure. While such reactions can be lifesaving under certain circumstances, when you're resting or after you exercise, the results are hardly desirable. They include muscle loss, mineral excretion, sodium retention and other enemies of bodybuilding progress.

For natural bodybuilders, meaning people who eschew all forms of pharmaceutical bodybuilding assistance, controlling cortisol is vital for muscle gains. Note the use of the word *controlling*. You don't want to totally eliminate cortisol activity in your body, as that would be a life-threatening condition.

The key is to control the catabolic reactions induced by cortisol while emphasizing the anabolic processes that promote increased muscle growth. You do that by upping your body's production of the endogenous anabolic hormones mentioned above by both following a sensible training program and using certain specific nutritional substances and diet techniques.

Let's get one thing straight, however. No natural food or supplement can match the power of drugs such as anabolic steroids. Such steroids promote muscle gains through two primary mechanisms: 1) increased muscle protein synthesis and 2) decreased catabolic reactions in muscle. The first mechanism involves a genetic alteration of certain protein synthesizing enzymes that simply can't be duplicated by any known food supplement; however, the second process, anticatabolism, can be manipulated without drugs.

Research concerning the mechanisms of anabolic steroids shows that most of their effects come from their anticatabolic activity. The upgraded protein synthesis is relatively ephemeral, lasting only a few weeks at best. After that it's all anticatabolic, as the steroids somehow counteract the actions of cortisol in muscle.

Exactly how they accomplish this anticatabolic activity is still subject to debate. While some people say that steroids block cellular cortisol receptors in a manner similar to the way another drug, Nolvadex, blocks estrogen cell receptors, that doesn't add up. For one thing, muscle tissue contains at least 50 times more cortisol receptors than androgen receptors, the receptors anabolic steroids



Recent studies show that consuming carbohydrates and protein immediately following a workout both increases insulin release and potentially blunts cortisol.

interact with. A more plausible explanation is that such steroids can interfere with cortisol activity in muscle, most likely at the gene level.

How Cortisol Breaks Down Muscle

Understanding cortisol's catabolic activity in muscle provides some insight into the way certain food supplements may help spare muscle by inhibiting it. Cortisol is known to reduce body protein stores in all tissues except for the liver. It does that through several mechanisms, including a reduction in the synthesis of cellular RNA, which is essential for protein synthesis. Since anabolic steroids promote muscle protein synthesis by increasing RNA, cortisol has exactly the opposite effect.

Cortisol mobilizes amino acids from muscle for transport to the liver, where they undergo a process called gluconeogenesis that results in increased glucose production. While this is vital for a rapid source of energy during severe stress, it also results in muscle breakdown. Insulin opposes cortisol in the action, but high stress activity promotes cortisol domination over insulin.



A study conducted about two years ago showed that as little as two grams of oral glutamine significantly increased growth hormone release. That alone would give you an anticatabolic effect, since growth hormone opposes the actions of cortisol in muscle.

Recent studies show that consuming carbohydrates and protein immediately following a workout both increases insulin release and potentially blunts cortisol. The dosage of carbs required for this effect is one gram per kilogram (2.2 pounds) of bodyweight taken immediately after training and again one hour later. In addition, including at least 50 grams of protein helps maximize insulin release.

Cortisol appears to promote the synthesis of a protein-degrading substance called ubiquitin that rapidly breaks down muscle. Interestingly, a drug called clenbuterol that's favored by some bodybuilders may work by inhibiting ubiquitin synthesis in muscle, thereby exerting an anticatabolic effect. Other hormones, such as growth hormone and insulinlike growth factor 1 (IGF-1), appear to inhibit the ubiquitin system as well.

Cortisol also works by stimulating the exit of the amino acid glutamine from muscle. When that occurs, rapid muscle catabolism follows. Several studies show that taking supplemental glutamine may block much of the catabolic effects of cortisol in muscle. The problem is, many of the studies that show an anticatabolic effect of glutamine used intravenous solutions containing a stable dipeptide—up to 40 grams of glutamine in a complex with another amino acid, alanine.

If you attempted to take that quantity of glutamine orally, most of it would not reach your blood or muscle. Intestinal cells, which are replaced about every three days as they slough off during the process of food movement through the gut, use glutamine as fuel. When you take it orally, about 85 percent of a dose of glutamine goes to the intestinal cells. Even if it were somehow to survive the intestinal hijacking, the liver has enzymes just waiting to degrade the rest of it.

Nevertheless, a study conducted about two years ago showed that as little as two grams of oral glutamine significantly increased growth hormone release. That alone would give you an anticatabolic effect, since growth hormone opposes the actions of cortisol in muscle. In fact, studies indicate that decreasing cortisol release in the body results in an upgraded growth hormone response.

Some preliminary studies show that vitamin C may also inhibit the catabolic actions of cortisol; however, the evidence is not particularly impressive. More likely, substances like branched-chain amino acids and even dietary fat are the nutritional cortisol inhibitors.

A new study reported at the 1997 meeting of the American College of Sports Medicine found that one of the branched-chain amino acids, leucine, successfully reduced the catabolic effects of cortisol in rat muscle without affecting muscle glutamine levels. That's interesting because past studies showed that BCAAs work by either increasing muscle glutamine synthesis or preventing its release under the influence of cortisol.

Another study, reported at the Experimental Biology 97 meeting in New Orleans, examined the effects of dietary fats on plasma hormones in runners. The study compared three levels of fat composition in the

diets of the runners: 17 percent, 32 percent and 41 percent. The results showed that the 32 percent fat diet significantly reduced cortisol levels in the runners compared to the 17 percent fat diet. Under the 42 percent, or high-fat, diet, cortisol levels increased only marginally. The diet lowest in fat produced the highest cortisol levels.

The authors of this study suggest that higher fat diets may help eliminate some of the excess cortisol release through an upgraded prostaglandin synthesis. Prostaglandins are hormonelike substances made from dietary fat that, among other actions, influence hormonal secretions. They were recently popularized by the best-selling diet book *Enter the Zone*, by Barry Sears.

Another possible explanation for the way a high-fat diet dilutes cortisol involves increased testosterone production. Testosterone has an inverse relationship to cortisol; that is, when testosterone is elevated in the blood, cortisol is depressed and vice versa. When testosterone is elevated, anabolic muscle reactions occur.

Natural bodybuilders seeking to key in to the anticatabolic effects of testosterone without using synthetic versions, such as anabolic steroids, often resort to purported testosterone precursors. These over-the-counter products fall into a gray area of legality due to the Food Supplement Act of 1994. Consequently, they are freely available and legal, at least for now.

One example of a reputed testosterone precursor is the adrenal hormone DHEA, which is produced in the pathway that begins with cholesterol and results in testosterone. That could be a problem, however, as DHEA, in some instances, may take divergent pathways, winding up as either an undesirable by-product of testosterone metabolism called dihydrotestosterone (DHT) or, even worse, estrogen. DHT is linked to male pattern baldness, prostate enlargement and acne, while estrogen, in males, leads to gynecomastia, increased fat deposition under the skin and water retention.

Those over age 40 will probably get the most benefit from DHEA. At that point in people's lives DHEA synthesis generally undergoes a precipitous drop, in which case conservative doses of 50 milligrams a day may take the desirable testosterone pathway by converting to the immediate precursor to testosterone, androstenedione.

Recently, androstenedione itself became available as an oral supplement. Some studies show that a liver enzyme can convert androstenedione directly into testosterone, which can increase plasma testosterone levels up to 300 percent over baseline for about two hours; however, it can also be converted by another enzyme, aromatase, into estrogen. In addition, no one has figured out how long an oral supplement of androstenedione continues to remain effective—assuming that it is effective for testosterone-raising purposes.

Still another over-the-counter hormone that has been suggested as a cortisol blocker is melatonin, a hormone synthesized in the pineal gland of the brain from the amino acid tryptophan. While melatonin is un-

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Anabolic/Anticatabolic Q&A

Q: *You've done a lot of research on insulin. Is it a bodybuilder's friend or foe? Should hardgainers try to get insulin surges throughout the day via high-glycemic-index carb intake to kick-start anabolism and blunt cortisol release, or will that have negative effects?*

A: Insulin is a storage hormone that has the capacity to increase fat deposition, foster carb storage as glycogen and help increase muscle protein synthesis by promoting amino acid uptake in muscle while blunting cortisol's catabolic effects. One study attributes 30 percent of muscle protein synthesis to insulin activity.

In addition, insulin may increase free or active testosterone levels through several possible mechanisms. These include inhibition of SHBG, a protein produced in the liver that binds to testosterone in the blood, thus keeping it dormant. Lowering SHBG increases free or active testosterone levels. Insulin may also promote the activity of an enzyme in the testes needed for testosterone synthesis. Finally, insulin may inhibit aromatase enzyme, which converts free testosterone into estrogen.

As such, insulin can be either good or bad, depending on how you control it. For most people attempting to produce insulin surges throughout the day will promote both hunger and increased bodyfat deposition. The main advantage to consuming frequent but small meals is that they support a more even insulin release, thus avoiding the surges produced by taking in too many calories—which promotes excessive insulin release and subsequent bodyfat synthesis.

I've noticed through the years that the types of diets that result in the lowest percentage of bodyfat in bodybuilders are those that control insulin release. Simply put, when insulin is controlled, you burn much more fat. That's the whole point of low-carb diets. For some people, however, such extreme

low-carb plans don't work well, but even for them, controlling insulin release through properly timed carb intake will result in greater bodyfat losses.

I think it's beneficial to have an insulin spike as soon as possible after training, since many studies show that increased insulin at that time promotes increased muscle glycogen synthesis, greater amino acid uptake into muscle and decreased cortisol. The best way to do that is to consume half a gram of simple carbs per pound of bodyweight along with enough protein to equal 40 percent of the carb dose. For example, a 200-pound bodybuilder would consume 100 grams of high-glycemic carbs with 40 grams of protein. Whey protein is the preferred postworkout protein source because it can be rapidly absorbed.

Adding glutamine to this mix may also help, since intense training causes glutamine to exit from muscle. Glutamine is important for maintaining optimal immune response and aids muscle protein synthesis. About four grams after training is a good dose, as too much will either be degraded in the liver or absorbed by intestinal cells. By the way, there's absolutely no evidence that combining glutamine with lysophosphatidylcholine, as is the practice with some current glutamine supplements, increases the uptake of oral glutamine. Lysocholine is, however, linked to duodenal ulcers and atherosclerosis.

One researcher a few years ago came up with the idea of consuming a simple carb-and-protein mixture during training. He noted that insulin secretion during exercise is usually depressed by epinephrine. He thought that consuming the nutrient mixture would overcome this brake and thus release insulin during training. The insulin released would preserve

The best protein supplements contain casein and whey protein along with glutamine peptides—an ideal mix that promotes optimal growth and less muscle wasting.

muscle and might even provide an anabolic effect.

The technique would be especially useful for hardgainers who have no carb-sensitivity problems, since it would maximize insulin output without the hazard of insulin's fat-promoting effect. The downside is that you'd have to drink at least two quarts of the stuff, and that could lead to an uncomfortable bloated effect in many people. In addition, the insulin produced by this method would totally obviate any fat-burning effect of the workout, and people with insulin insensitivity may acquire more bodyfat than lean mass.

Another way to control cortisol release involves using a phosphatidylserine (PS) supplement. A new study that used active bodybuilders was recently presented at the American College of Sports Medicine meeting in Orlando, Florida. This study confirmed that PS does indeed safely inhibit cortisol release, lowering it by around 30 percent. This represents a significant—but safe—decrease in cortisol output. You never want to totally curtail cortisol, since that could be fatal.

A few emerging animal-based studies also show that ginkgo biloba, a substance derived from some of the world's oldest trees, also appears to lower cortisol output in a manner similar to PS. Since those new studies don't involve human subjects, the results must await confirmation in studies that do. Unless you want to use ginkgo as a brain nutrient, stick with PS for cortisol control for now.

—Jerry Brainum, *bodybuilding and nutrition researcher*

Q: *Does the food supplement phosphatidylserine offer any real bodybuilding benefits? If so, is there any scientific data to prove its efficacy?*

A: PS, as it's known, is a phospholipid, a combination of fatty acids and phosphorus plus the amino acid serine. It's a ubiquitous substance in the body, found in cell membranes, and research has shown that the body's synthesis of PS may not be optimal as people age. Since much of a person's PS is concentrated in the brain, which is composed mostly of fat, older people may be deficient in the substance—a notion that's underscored by several well-controlled studies. In the experiments researchers found that providing an average dose of 300 milligrams per day of PS to older people who have memory defects seemed to help them.

The idea of using PS to combat stress reactions induced by high cortisol levels first surfaced in a 1990 study reported in the journal *Neuroendocrinology*. In 1992 the same researchers published another study that pointed to an athletic use for PS. That study involved untrained cyclists who took 800 milligrams of PS for 10 days prior to exercising on bicycles to near exhaustion. The results indicated that PS appeared to lower cortisol by about 30 percent. The effect was noted only for an 800-milligram dose; however, 400 milligrams didn't have the same effect on cortisol release.

Cortisol is a stress hormone produced in the adrenal cortex. The con-

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Since the anabolic hormones are required for optimal muscle protein synthesis, the effect of cortisol in breaking down muscle and interfering with new muscle growth via anabolic hormone release clearly points to the need to control, but not to eliminate, cortisol release.

Control of cortisol is based on a hormonal cascade effect involving an initial release of corticotropin-releasing hormone from the hypothalamus, followed by ACTH from the pituitary gland. ACTH then travels in the blood to the adrenal glands, where it dictates the release of several hormones, including cortisol.

Cortisol has acquired a bad reputation among bodybuilders because of its catabolic, or breakdown, effects in muscle. Muscle tissue is loaded with cortisol hormone receptors; in fact, cortisol receptors outnumber androgen receptors by 50 to 1. In muscle cortisol promotes the breakdown of muscle amino acids, which then travel in the blood to the liver, where they're converted into glucose in a process called gluconeogenesis.

While it sounds bad, the breakdown of muscle protein induced by cortisol is a protective function of the body that's designed to provide needed fuel (glucose) under high-stress conditions. Unfortunately, the body doesn't differentiate between good stress and bad stress, so the stress of exercise results in the same cortisol catabolic effects as trauma to the body. In addition, cortisol suppresses immune response, which explains why it's so much easier to get sick when you're under stress. Even sleep disturbances can lower immune response by 40 percent.

Cortisol also has an inverse relationship to anabolic hormones, such as testosterone, growth hormone and insulin. When cortisol is elevated, the other hormones are depressed. Since the anabolic hormones are required for optimal muscle protein synthesis, the effect of cortisol in breaking down muscle and interfering with new muscle growth via anabolic hormone release clearly points to the need to control, but not to eliminate, cortisol release.

Some athletes resort to drugs that either block the effects of cortisol or inhibit its synthesis in the adrenal glands. Examples of blocking drugs include anabolic steroids, which are synthetic forms of testosterone. While the precise mechanism behind the cortisol-inhibiting effect of anabolic steroids isn't known, one theory holds that steroids exert a competitive inhibition against the binding of cortisol to its cell receptors in muscle. The theory is complicated, however, by the fact that there are far more cortisol receptors in muscle than androgen receptors. Most of the long-term effects of anabolic steroids in promoting muscle growth and recovery are related to the cortisol-inhibition effect.

Another popular drug for controlling cortisol is aminoglutethimide, often sold under the trade name Cytadren, which works at the adrenal level by preventing the synthesis of cortisol that begins with cholesterol. While effective for that purpose, Cytadren may also produce such side effects as nausea, vomiting, bone marrow depression and skin rashes.

I recall an instance a few years ago, in which I was called to the room of a top-level pro bodybuilder who was preparing to compete in a major contest. He complained of severe lethargy and appeared to have difficulty keeping his eyes open. When I asked him what he was taking,

he replied, "Cytadren and Orimeten." No wonder he was lethargic: He was doubling up on the same drug because Orimeten is another trade name for it. Lethargy, such as the man experienced, occurs in 40 percent of people taking aminoglutethimide.

In truth, any anabolic drug, including IGF-1, growth hormone, anabolic steroids and insulin, can block most of the catabolic effects of cortisol. Those drugs, however, are not only illegal without a prescription, but they also have potential side effects. For a person primarily interested in health, such drugs aren't an option for cortisol control. That's where PS enters the picture.

Based on the two studies discussed above, PS has been suggested as a natural alternative for cortisol control, with the usual dose being 800 milligrams a day. A major criticism of that suggestion, though, is the lack of studies showing that it provides benefits for people engaged in intense weight training. After all, riding a bike is one thing in terms of muscle stress, but hoisting heavy weights several days a week is quite another.

The dearth of studies concerning the effects of PS on an active weight-training population led researchers Tom Fahey and Michelle Pearl of California State University, Chico, to design a new study for that purpose. Their experiment incorporated a double-blind, crossover design, meaning that neither the researchers or the subjects knew who was getting PS and who was getting a placebo. The placebo in this case consisted of lecithin, a good choice, since lecithin, like PS, is derived from soybeans. Fahey and Pearl presented their results at the recent American College of Sports Medicine meeting in Orlando, Florida.

The study featured 12 fit males with at least four years of weight-training experience (one man dropped out of the study due to appendicitis), who were all in good health and took no anabolic steroids or any other performance-enhancing drugs. They participated in a two-week training period consisting of four sessions a week. The workouts were especially intense whole-body sessions, in which the subjects trained with heavy weights, averaging five sets per exercise. Large muscle groups were emphasized in the routines, which were designed to promote overtraining.

The men were assigned to either a PS group or a placebo group. The men receiving genuine PS used a dosage of 800 milligrams a day. At the end of two weeks the subjects took a three-week break, then switched treatments—the "crossover" design—for another two-week period of supplementation and training. Fahey and Pearl measured various hormone levels during the course of the study, including cortisol, ACTH, luteinizing hormone (LH) from the pituitary gland and testosterone. The muscle enzyme creatine kinase was also assessed as a measure of exercise-induced muscle damage, and the subjects reported subjective feelings of well-being and muscle soreness.

During the first days of training cortisol levels were similar in both the PS and placebo groups, but by the eighth workout the PS group

Some athletes resort to drugs that either block the effects of cortisol or inhibit its synthesis in the adrenal glands. Examples of blocking drugs include anabolic steroids, which are synthetic forms of testosterone.

When cortisol remains elevated, the body turns on itself, literally feeding on hard-earned muscle, which is broken down into amino acids and converted to glucose in the liver in a process called gluconeogenesis.

showed lower cortisol levels. Levels of ACTH, which controls cortisol release, didn't change in the PS men, but they rose by 50 percent in the placebo group. Testosterone initially increased in the PS group, but it dropped in both the PS and placebo groups by the end of the study. That isn't surprising when you consider that the men were purposely over-training, which has an established effect in blunting testosterone release. LH also rose only in the PS group.

The men taking the PS reported a greater feeling of well-being and less muscle soreness, both of which were based on a 10-point subjective scale. The researchers concluded that PS appears to lower cortisol after exercise and increase feelings of well-being while blunting muscle soreness. Similar to the results of older studies on PS, those findings suggest that the mechanism involves a PS-induced inhibition of ACTH release by the pituitary gland. The fact that ACTH didn't rise in those taking PS but did in the placebo group substantiates that idea.

Fahey and Pearl's preliminary study suggests that PS may be an effective and safe way to control cortisol output without resorting to potentially dangerous drugs. Although the men in the new study reported less muscle soreness, anecdotal reports from bodybuilders who have used PS indicate that a common side effect is increased joint soreness.

While that may not be comfortable, it also indicates that PS may work as advertised. Cortisol is a potent anti-inflammatory hormone in the body, and anything that interferes with cortisol activity is capable of producing joint tenderness, which is also a commonly seen side effect of the potent cortisol-suppressing drugs discussed above.

—Jerry Brainum, bodybuilding and nutrition researcher

Q: I keep reading about cortisol and its relationship to muscle catabolism. If it's so destructive, why does the body produce it, and how can I stop it from slowing my muscle growth?

A: The answer to that question lies deep in our DNA. Cortisol is actually a holdover from our 4-million-year-old genetic design. When the body is stressed, it triggers the "fight or flight" survival mechanism, which can shoot cortisol levels way above normal. The biological design of cortisol is such that when primitive man was threatened or angry, cortisol levels rose and mobilized his body for action by breaking down fat and muscle stores to use for emergency fuel and to reduce swelling in the event of injury.

For today's serious athletes training is trauma, and the body interprets every workout as a threat to survival. Mental stress produces the same negative response in the body as physical stress. The one-two punch of modern physical and mental stressors results in overload, which can leave your adaptive system overwhelmed by ongoing calls for cortisol production. As a result, cortisol levels may not get a chance to return to normal for long periods, and when cortisol remains elevated, the body turns on itself, literally feeding on hard-earned muscle, which is broken down into amino acids and converted to glucose in the liver in a process

called gluconeogenesis.

Higher cortisol levels also reduce or even block the entry of anabolic building blocks essential for protein synthesis. That means when cortisol is high, expensive dietary amino acid and protein supplements are less likely to do their main job of cellular repair and growth.

Anabolic steroids appear to inhibit the catabolic effects of cortisol. It's a known fact that cortisol levels skyrocket when athletes stop using steroids. Phosphatidylserine (PS) is a natural substance that has been shown to suppress cortisol by more than 30 percent, which is why I think it's the king of the anticatabolic compounds. And it can actually amplify the effects of other supplements.

A number of European studies verified the anticatabolic effects of PS, and more recently Thomas Fahey of California State University, Chico, did a study with PS and anaerobic athletes. It once again proved its tremendous power by reducing blood cortisol levels during and after bodybuilding-type workouts, lighting the fuse for explosive size-and-strength increases.

This underscores the fact that PS supplements like Muscle-Link's Cort-Bloc should be a staple of all mass-seeking bodybuilders, especially those who don't use drugs. Choke off the devastating effects of cortisol and you'll grow as you never have before.

—Bob Fritz, research-and-development technician, Muscle-Link

Q: I've tried Cort-Bloc and made great gains with it, but someone told me that blocking cortisol can be dangerous. Is that true?

A: Blocking cortisol completely, as some drugs such as Cytadren do, for long periods can be dangerous; however, the study done with phosphatidylserine by Thomas Fahey showed that the natural compound suppressed cortisol by about 30 percent. That percentage isn't high enough to be dangerous, but it is enough to reduce catabolism and have a significant beneficial effect on muscle growth.

If you're still not convinced, check out Jerry Brainum's *Applied Metabolics* #13. He discusses a new study that was reported in the *Journal of Applied Physiology* (1998) that looked at the effects of low cortisol during exercise. Jerry's conclusion of the study is as follows:

While cortisol is important, blocking its effects during exercise isn't harmful and doesn't adversely affect exercise performance. The reason is that when cortisol is blocked, the activities of other hormones that regulate blood glucose levels—such as growth hormone, epinephrine and norepinephrine—increase to counter the effects of lowered cortisol.

That means your great gains from Cort-Bloc were not only due to reduced catabolism but were no doubt the result of a nice uptick in growth hormone as well. It also means that controlling cortisol with phosphatidylserine is completely safe. [A 12-issue subscription to *Applied Metabolics* is \$29.95 for domestic, \$49.95 for foreign and Canadian. Call (805) 570-4766.]

—Steve Holman, editor in chief, IRONMAN

Anabolic steroids appear to inhibit the catabolic effects of cortisol. It's a known fact that cortisol levels skyrocket when athletes stop using steroids.

Because cortisol can cripple your GH release, taking a PS supplement right before bed can make your natural GH pulse that occurs during the first few hours of sleep much stronger. The result will be better recovery and more muscle growth.

Q: When should I use Cort-Bloc for best effects?

A: Even if you're not using GH Stak, you can still get tremendous anabolic, anticatabolic benefits from Cort-Bloc. My advice is to use it at two strategic times during the day to decrease catabolism, increase growth and recovery and heighten your natural GH surges. First, use it before you train to help blunt the effects of cortisol, which will increase significantly during and right after you train. The second strategic time to take it is about an hour before bed. Because cortisol can cripple your GH release, taking Cort-Bloc right before bed can make your natural GH pulse that occurs during the first few hours of sleep much stronger. The result will be better recovery and more muscle growth.

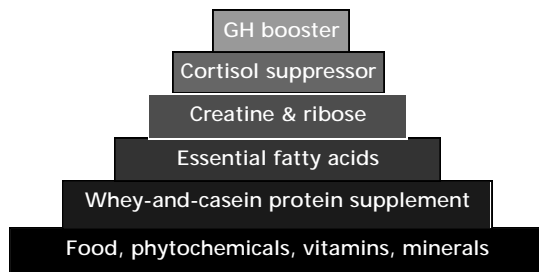
If you're taking GH Stak before bed, you'll want to take your Cort-Bloc with your last meal at around 7 p.m., instead of right before you go to sleep. Your stomach has to be empty to maximize the effects of the GH Stak, so make sure you take your Cort-Bloc three hours before your GH Stak.

—John Balik, publisher, IRONMAN

Q: Please outline a diet and supplement schedule that incorporates the most effective supplements so I can grow as quickly as my genetics will allow.

A: The diet/supplement schedule on the next page is an excellent one to start with; however, keep in mind that it is just a template. You'll probably have to adjust portions to find your perfect calorie total. The supplements are based on the anabolic/anticatabolic pyramid, which appears in *Size Surge 2*.

—Steve Holman, editor in chief, IRONMAN



ANABOLIC/ANTICATABOLIC DIET AND SUPPLEMENT SCHEDULE

6:30 a.m.:				
Effervescent Creatine Elite, 1 packet (5 grams) or AnaVol-R				
7 a.m.:	Calories	Protein	Fat	Carbohydrates
Protein drink, such as Muscle-Link's Pro-Fusion*	200	40	2	5
Oatmeal, 8 ounces	150	5	3	25
Egg whites, 2 stirred into oatmeal	20	6	—	—
1 rice cake with peanut butter (1 1/2 tablespoons)	218	8	14	15
Dates, 1/4 cup (about 5 whole dates)	137	1	—	33
Totals	725	60	19	78
9:30 p.m.:				
Multivitamin and -mineral supplement; Omega Stak, 2,000 milligrams				
Calories	Protein	Fat	Carbohydrates	
Meal replacement, such as Muscle-Link's Muscle Meals*	310	40	11	11
Apple	88	—	—	22
Totals	398	40	11	34
Noon				
Calories	Protein	Fat	Carbohydrates	
Roasted chicken, 6 ounces	232	40	8	—
Broccoli, 6 ounces	45	4	—	8
Rice, 1 cup	124	4	—	27
Totals	401	48	8	34
4 p.m.:				
PS (cortisol-control compound, such as Cort-Bloc), 400 milligrams; Omega Stak, 2,000 milligrams; Ribose Size, 2.2 grams				
Calories	Protein	Fat	Carbohydrates	
Meal replacement, such as Muscle-Link's Muscle Meals*	310	40	11	12
5 p.m.:				
Effervescent Creatine Elite, then work out				
6:30 p.m.:				
Vitamin C, 500 milligrams, Vitamin E, 500 international units Beta-carotene, 20,000 international units; Ribose Size, 2.2 grams				
Calories	Protein	Fat	Carbohydrates	
Protein drink, such as Muscle-Link's Pro-Fusion mixed in	200	40	2	5
Orange juice, 3 cups	312	3	—	75
7 p.m.:	Calories	Protein	Fat	Carbohydrates
Cottage cheese, 6 ounces	162	22	6	5
Peanuts (handful)	110	5	8	2
Totals	784	70	16	87
10:30 p.m.:				
PS (cortisol-control compound, such as Cort-Bloc), 400 milligrams; Omega Stak, 2,000 milligrams				
Calories	Protein	Fat	Carbohydrates	
Protein drink, such as Muscle-Link's Pro-Fusion*	200	40	2	5
Grand Totals & Macronutrient percentages	2,818	298	67	251
		42%	22%	36%

Note: When you use GH Stak or AnaVol-R before bed on an empty stomach, move your 10:30 p.m. protein drink to noon, add it to that meal, and take your PS and EFA supplements with your 7 p.m. meal.



***Supplement
Testing***

8



IRONMAN Research Team

The first installment of the *IRONMAN* Research Team Supplement Testing series appeared in the December '99 *IRONMAN* and received a tremendous response. It was essentially created to allow bodybuilders to try specific supplement stacks and then report their findings via an in-depth questionnaire. To make it cost-effective for those participants, the supplement stack was offered at a deep discount to the first 200 people to become a member of the team—no strings attached other than feedback on the supplements. The feature was so popular, it became a regular feature in *IRONMAN*, and now we want to give those who have read this book and understand proper supplementation a chance to try those same supplement stacks at the same deep discounts.

IRONMAN Research Team 1: Triple-Gain Special

So you've read about all the new scientifically sound size-building supplements, but using them means losing your electricity and phone service. (Paying bills and stocking up on the hottest new supplements can sometimes be mutually exclusive.) How frustrating—and gain stifling. Without electricity, you can't whip up your postworkout protein shake.

The *IRONMAN* Research Team's original solution was to offer you a single new supplement at big savings in return for your feedback. That was a step in the right direction, but we've decided to one-up the original solution—make that two-up. Now you get three supplements at a deep discount in return for your feedback. That's right, a triple savings. The reason we're upping the ante is because we want you to try the best products at reduced prices, and we want you to experience the incredible synergistic effects specific supplements can produce.

It's no secret that a lot of supplements work best with companion compounds. In other words, they synergize with one another, which can significantly increase their effectiveness and magnify your

gains. For example, ribose and creatine work exceptionally well together to fortify muscle ATP, producing more new power at every workout, which in turn triggers new hypertrophy in your muscle fibers. In essence, you get bigger and stronger faster than if you used those products individually during different training phases. Throw in the best meal replacement in the business, which helps you stay in positive nitrogen balance throughout the day and spikes your vitamin-and-mineral intake, and you have an arsenal of core mass-building supplements that can do incredible things to your muscle size and power.

You may be thinking, "Wow, effervescent creatine, ribose and the best meal replacement around at a deep discount. What's the catch?"

None. Nada. Zip—other than your feedback. We're making this offer so you can try specific products and then fill out a short questionnaire about your experience so we can do a follow-up feature on supplement testing in a future issue of *IRONMAN*. That's it. We'd also like to get your before and after photos to help illustrate the feature. We'll even throw in an *IRONMAN* Training & Research Team T-shirt—don't forget to give us your size.

We've chosen Muscle Meals, Effervescent Creatine Elite and Ribose Size because they complement the ITRC Muscle-Building Programs featured in the magazine. Use a rock-solid training strategy with these three exceptional mass-building supplements, and you can significantly amplify your size and strength gains.

Muscle Meals. If you're a serious bodybuilder, you use a meal replacement or protein powder. It's almost mandatory if you want to get the enormous muscle-building, fat-burning benefits of eating six meals a day. The new-breed meal replacements not only contain a fusion of various proteins, such as whey and micellar casein for fast anabolic uptake and a slow anticatabolic trickle-feed effect, but they're also packed with vitamins, minerals and glutamine peptides. Muscle-Link's Muscle Meals fills the bill perfectly—and its new improved taste is delicious. It's the ultimate meal replacement on the market, jam-

The new-breed meal replacements not only contain a fusion of various proteins, such as whey and mycellar casein for fast anabolic uptake and a slow anticatabolic trickle-feed effect, but they're also packed with vitamins, minerals and glutamine peptides.

packed with everything your body craves to feed its muscle-building needs, including 10 grams of glutamine peptides per serving (and no aspartame). Each 20-packet box sells for \$59.95, but call now and you can get the *IM* Research Team price: Buy one, get one free—you save almost \$60. That's two big boxes for the price of one.

Effervescent Creatine Elite. Effervescent technology has made the number-one bodybuilding supplement almost three times better than the standard powdered variety. Effervescence separates the creatine from its salt, or monohydrate, creating free-ionized creatine, which is almost 100 percent absorbed. Most people only absorb 30 percent of a standard five-gram dose of regular powdered creatine monohydrate. Effervescent creatine's better absorption is the very reason a research study performed at a leading university showed that it increased anaerobic work capacity 194.9 percent more than powdered creatine and 84 percent more than the most popular creatine transport, creatine plus carbs. In addition, due to buffering, effervescent creatine produces no stomach upset. There's no grit and no bitter aftertaste. The retail price is \$29.95 for a 20-packet box, but you'll need one box to load and one for maintenance, so *IM* Team Members get a second box free—once again, two boxes for the price of one.

Ribose Size. There's a lot of information out on D-ribose these days, so you no doubt understand its tremendous impact on muscle recovery and growth. Basically, it's a compound that can supercharge your ATP along a different pathway than creatine, which makes it uniquely synergistic with that compound. In fact, it's been the focus of more than 150 peer-reviewed studies, and experts are saying that many athletes hit plateaus and overtrain due to ribose depletion. Ribose, with its recovery- and muscle-energetics-boosting components, is the most effective supplement to hit the bodybuilding market in years. It retails for \$49.95 for each 100-gram bottle. Agree to test it, and we'll throw in a second bottle free.

Okay, let's recap. If you're one of the first 200 people to call, you get the following:

•Two boxes (40 packets) of Muscle Meals for the price of one.

•Two boxes (40 packets) of Effervescent Creatine Elite for the price of one.

•Two 100-gram bottles of Ribose Size for the price of one.

•An *IRONMAN* Training & Research Center T-shirt.

All for only \$149.95 (you save about \$150).

That's about a \$300 value, but you get it all for only \$149.95 plus shipping—almost half price. To put it more plainly, you save about \$150 for a one-month supply of some of the best core mass-building supplements around—and all you have to do in return is give us feed-

back on the products after you use them for one month and, if you can swing it, before and after pictures to use in an upcoming feature. Call immediately to take advantage of this offer, and we'll rush your supplements to you. Join the *IM* Research Team, test hot new supplements and get big! Building a great physique just got a heck of a lot easier—and a lot less expensive—thanks to this new supplement-testing program. Call Home Gym Warehouse at 1-800-447-0008 today and ask for the *IM* Research Team Triple-Gain Special, and start making the best gains you've ever made.

IRONMAN Research Team 2: GH-Boosting Special

Growth hormone is getting a reputation as a miracle rejuvenating compound. According to a bevy of studies, a surge in your GH can increase your muscle mass; burn bodyfat; strengthen connective tissues, including tendons and ligaments; help heal injuries; revitalize your skin and hair; bolster your immune system and give you more energy. It's no wonder drug companies have been overwhelmed by the demand since GH was first introduced more than two decades ago. Today aging baby boomers consider it the Fountain of Youth, which is driving demand even higher.

Most bodybuilders couldn't care less about revitalizing skin and hair, but GH's muscle-building, fat-burning potential has lured them to it like nerds to a "Star Trek" convention. Bodybuilders began experimenting with GH in the late '80s and early '90s, and now almost every pro is using or has used it. Many experts believe that human growth hormone is so powerful, it's the reason physique athletes are so much bigger and leaner now than they were in past decades. In fact, GH may be the single biggest reason there are so many behemoths stalking the stages at pro contests—it's the ultimate muscle-building, fat-burning compound, especially when used in conjunction with other substances—legal or otherwise.

Scientists are beginning to understand that GH has synergistic reactions with other anabolic hormones in the human endocrine system, including testosterone. The problem is, GH is a prescription drug that you have to administer intramuscularly. So the question becomes, How do you increase your GH naturally to harness its amazing power without having to inject it and risk dangerous side effects? The answer is, you take advantage of scientific training techniques and supplements that are based on the latest research.

Training for GH release involves keying in on the big compound exercises, like squats and rows, and also getting a burn in the target muscles by supersetting exercises and/or using other set-extending techniques. If you want an even bigger, better surge, you should use supplements that complement those strategies, specifically GH Stak, an effervescent growth hormone booster, and Cort-Bloc, a cortisol-

According to a bevy of studies, a surge in your GH can increase your muscle mass; burn bodyfat; strengthen connective tissues, including tendons and ligaments; help heal injuries; revitalize your skin and hair; bolster your immune system and give you more energy.

Cortisol and GH are mortal enemies. Studies have demonstrated that GH's anabolic effects are blunted when cortisol level is high. Scientists think cortisol reduces the number and/or the responsiveness of GH receptors to growth hormone.

control compound.

GH Stak and Cort-Bloc synergize to ratchet up your natural growth hormone levels. As *IRONMAN*'s European researcher Michael Gündill explained, "When GH users are unhappy with their results, the culprit is usually cortisol. Cortisol and GH are mortal enemies. Studies have demonstrated that GH's anabolic effects are blunted when cortisol level is high. Scientists think cortisol reduces the number and/or the responsiveness of GH receptors to growth hormone. What's more, high-cortisol secretion is usually associated with a reduced GH secretion. Research has shown that GH boosters fail to elevate GH secretion whenever cortisol is high." That pretty much sums up the synergy of the two supplements. Here's how and why they work.

GH Stak. New research points to a number of amino acids along with a host of other compounds that together can create a growth hormone tidal wave. One supplement that incorporates all of the latest research into a powerful GH-releasing compound is Muscle-Link's GH Stak.

Bodybuilders at the *IRONMAN* Training & Research Center have been experimenting with this product, effervescent tablets—like Alka Seltzer—that you dissolve in water and drink either before you train or at bedtime on an empty stomach. During the test phase of GH Stak



drug-free bodybuilder Jonathan Lawson made some spectacular gains using it, adding more than 10 pounds of muscle to his ripped competition weight the first time he tried the product for an eight-week cycle (see his before and after photos in the GH section of this book). He got that amazing result thanks to GH Stak, Cort-Bloc and his high-intensity Positions-of-Flexion training protocol, which incorporates stretch-position exercises. Stretch-position exercises are important because inordinate muscle elongation can increase growth hormone and insulinlike growth factor 1 (IGF-1) receptors. Perform them in high-intensity fashion with a GH Stak kicker, and you'll light the anabolic fuse that can ignite explosive muscle hypertrophy. According to GH Stak's developer, noted pharmacologist James Jamieson, who also invented the patch delivery system for drugs, you get a synergistic effect from the compounds in the effervescent supplement and the GH-releasing effects of high-intensity exercise.

Why is GH Stak in an effervescent form? Because studies show that there's a significant increase in GH from oral glutamine when the glutamine is in that form. The effervescent action also enhances the delivery of other growth hormone precursors, such as L-arginine, which is included in GH Stak in a more bioactive pyroglutamate form than what you get from standard L-arginine supplements.

GH Stak also contains anterior pituitary peptides that normalize somatostatin, a hormone that can shut down GH and IGF-1 receptors. That's extremely important because when you elevate GH and IGF-1, you don't want somatostatin to smother their effects. GH Stak's anterior pituitary peptides prevent the shutdown, which drastically increases the effects.

As for the research, an unpublished study on GH Stak showed that bodybuilders had anywhere from a 12 percent increase in IGF-1 levels after just one day of using the supplement all the way to a 36.6 percent increase after only six days. The results have been so spectacular that doctors at anti-aging clinics are using this product in place of GH injections. (IGF-1 levels are more stable and have a direct correlation to GH levels, which is the reason they're used to measure GH output.)

A one-month supply, or half cycle, of GH Stak retails for \$79.95, but if you call now you can get the *IM* Research Team special, a deep discount that's outlined below.

Cort-Bloc (phosphatidylserine). With intense training comes increased cortisol, a stress hormone that can cannibalize muscle tissue and blunt the anabolic effects of GH. Fortunately, one compound can fight that negative effect and in turn increase the power of GH: phosphatidylserine. In two Italian studies PS showed impressive anticatabolic properties in endurance athletes, suppressing cortisol by more than 30 percent. In a recent study by professor Thomas Fahey of California State University, Chico, it was shown that soy-based PS reduced blood cortisol during and after bodybuilding-type workouts by

In a recent study by professor Thomas Fahey of California State University, Chico, it was shown that soy-based PS reduced blood cortisol during and after bodybuilding-type workouts by almost 30 percent.

Because creatine is an osmotic catalyst, it can force more water into the muscle cells, giving the muscle structures a fuller, rounder appearance. That's what accounts for some of the initial weight gain creatine users experience.

almost 30 percent, an especially important finding for weight trainers who classify themselves as hardgainers.

Cortisol production is a primitive mechanism that's triggered when the fight-or-flight response is invoked. That means, if you're under a lot of stress during the day, cortisol could be causing your body to waste muscle tissue at almost every turn. It's believed that hardgainers are cortisol overproducers. In addition, the body perceives intense workouts as a threatening stress and, therefore, pumps cortisol into your system after every hard training session. It also perceives hunger as stress, a key reason to take a cortisol-control supplement like Cort-Bloc with your last meal at night prior to the three-hour fast that precedes your growth hormone booster. Remember, you want your cortisol to be low when you take your GH booster because cortisol blunts GH's anabolic effects.

With so many factors causing cortisol release and impending muscle catabolism, is it any wonder that it's so hard to build muscle? The catabolic facts regarding cortisol make it obvious that PS should be on every bodybuilder's supplement list, especially high-strung individuals who generally overproduce cortisol. Take it prior to your workouts, and by reducing your cortisol levels, you'll also get more anabolic power from your GH. By the way, Cort-Bloc contains vitamin B6, which has been linked to increases in natural growth hormone output.

Cort-Bloc retails for \$49.99 for one 60-capsule bottle. Call now, agree to test it, and we'll throw in a second bottle at a deep discount. We'll also throw in an *IM* Training & Research Center T-shirt. The number is 1-800-447-0008. Ask for the *IM* Research Team GH-Boosting Special. So, to summarize, make that call and you get the following:

- Two boxes of GH Stak (60-day supply).
 - Two 60-capsule bottles of Cort-Bloc.
 - An *IRONMAN* Training & Research Center T-shirt.
- All for only \$159.95 (you save more than \$100).

That's \$260 worth of supplements, but you get it all for only \$159.95 plus shipping and handling. In other words, you save more than \$100 for a two-month supply of two of the best growth-hormone-boosting supplements around—and all you have to do is give us feedback on the products and before and after pictures to use in an upcoming feature. If you don't feel particularly photogenic, you can skip the photos, but we do want extensive feedback via the questionnaire and comments after you make your spectacular progress. (That's what we get out of the deal, feedback to use in a future supplement feature in *IRONMAN*—and before and after photos are a big plus.)

Call 1-800-447-0008 immediately to take advantage of the *IM* Re-

search Team GH-Boosting Special. Ask for it when you call—don't forget to give us your T-shirt size—and we'll rush your supplements to you to test. Join the Team, test hot new supplements and get big from your workouts! It's a plan to grow on.

IRONMAN Research Team 3: Cell XL Special

Bodybuilders know that certain compounds can make muscle tissue engorge, or swell. Creatine is one. Because it's an osmotic catalyst, it can force more water into the muscle cells, giving the muscle structures a fuller, rounder appearance. That's what accounts for some of the initial weight gain creatine users experience. Be aware, however, that many of the high-sugar formulas, with up to 75 grams of sugar per serving, can also cause fat-cell volumization. That equates to a whopping 1,200 extra calories a day during a loading phase, so what you get with those formulas is some muscle-cell volume from creatine and lots of fat-cell swelling from sugar overload—not what most bodybuilders are after.

Bodybuilders want volumization to occur only in muscle cells and to leave the adipose-cell volumization to the circus fat man. While research isn't plentiful, there have been a handful of studies done on increasing muscle-cell volume through nutrition—and with the plague of muscle-wasting diseases ravaging mankind, there should be many more in the future.

Researchers at Ergogenix LLC pored over all the studies that were even remotely linked to cell volumization. After weighing all the evidence and testing numerous compounds, they've designed the definitive muscle-cell volumizer for Muscle-Link, AnaVol-R. It was created specifically for bodybuilders who are looking for muscle size without bodyfat gain. Here are the ingredients and an explanation of each as they appeared in the feature "Anavolics" in the November '99 *IRONMAN*.

Creatine monohydrate, five grams. When creatine was first introduced into the market, one of the main effects touted was cell volumizing. Recently, a study by Ziegenfuss, Lowery and Lemon was published online in the *Journal of Exercise Physiology* (October 1998); it showed a 3 percent increase in water inside the cell after a three-day loading routine. That's consistent with the results most of us see with creatine loading: a gain of about 2 to 3 percent of bodyweight during loading (four to six pounds for a 200-pound person). What about creatine solubility? AnaVol-R is titrated, or balanced, at a pH of approximately 4.5. That's the pH at which creatine is soluble, just as occurs in the effervescent formulas. Five grams of creatine, delivered at a pH of 4.5, should be absorbed well and tolerated well.

D-ribose, two grams. D-ribose (the R in AnaVol-R) is a new-

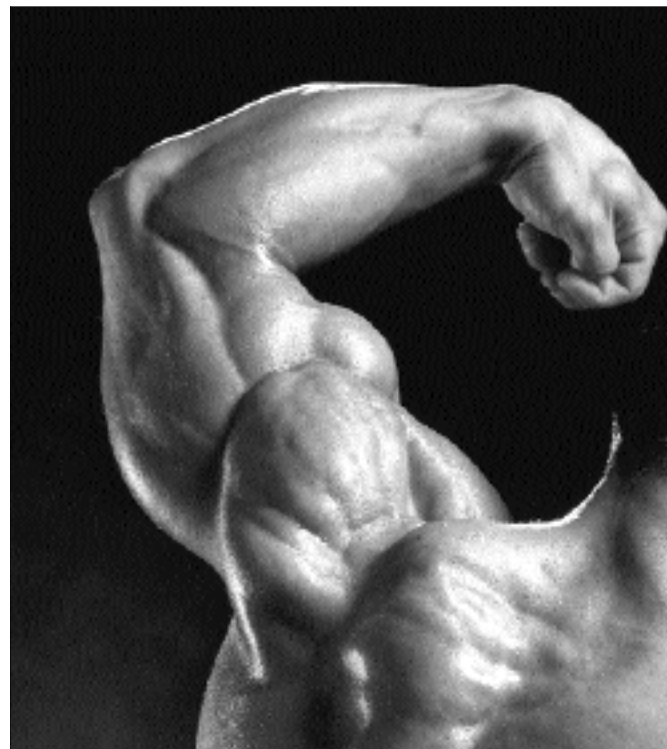
Bodybuilders want volumization to occur only in muscle cells and to leave the adipose-cell volumization to the circus fat man. While research isn't plentiful, there have been a handful of studies done on increasing muscle-cell volume through nutrition.

AnaVol-R is designed to promote cell volume increases to support an anabolic phase of metabolism. It's designed to allow—even force—your body to grow.

comer to sports nutrition. That's not because it was undiscovered, but because it couldn't be manufactured cost-effectively until recently. Numerous studies are looking at the use of D-ribose for low-cellular-energy states in disease and ischemic conditions. They've all shown a positive effect of D-ribose supplementation on adenosine triphosphate (ATP) and total adenine nucleotides (TAN). The benefit of adding D-ribose to AnaVol-R is twofold. First, by maintaining cellular ATP, it ensures that cellular energetics are favorable toward the anabolic processes. Second, if the high turnover in ATP required by exercising muscle affects cellular ATP, it may also affect other nucleotides. What does that mean exactly? We've all heard of DNA and RNA. The acronyms stand for deoxyribonucleic acid and ribonucleic acid. If you look carefully, you'll see the prefix ribo-, as in ribose, or D-ribose. DNA and RNA are the genetic molecules that determine the structure and function of all human cells. If we are robbing the cell energy nucleotide pool, we may be affecting the nuclear, or genetic, nucleotide pool, which is not a good thing. D-ribose, at the very least, will support the formation of new ATP and repair or salvage existing ATP (Brault, J.J., and Terjung, R.L., 1999). Possibly, it may aid in promoting the cell's ability to respond to stimuli such as training or volume changes (Bernofsky, 1980; Coffey, et al., 1965; Hellsten-Westing, et al., 1993). What's more, D-ribose also aids in the insulin response of AnaVol-R (Goodman, C., and Goetz, F.C., 1970; Malaisse, W., and Malaisse-Lagae, F., 1969).

Pinitol (or Inzitol™), 50 milligrams. Pinitol is a methylated sugar (3-O-methyl-1,2,4 cis-3,5,6 trans hexahydroxycyclohexanol) that has two effects of significant value: increased glucose uptake by the muscle cell and increased glycogen synthesis. Pinitol is an isomer, or type, of inositol. It's extracted from soy and sugar pine heartwood. It was first discovered to have hypoglycemic effects—that is, it lowers blood sugar—in 1987 (Narayanan, C., 1987) and later found to enhance insulin function as well.

Pinitol was first discovered in the methanol fraction of *Bougainvillea spectabilis*, a botanical used in traditional healing for many purposes, including diabetic-associated conditions. It was later found to be a component of pH 2.0 D-chiro-inositol glycan insulin putative mediator (Fonteles, M.C., et al., 1996). Infusion of pinitol leads to an insulinlike action without causing hypoglycemia. Therapeutically, that's very important, as it demonstrates some means of regulatory control to prevent the negative consequences of hypoglycemia. To the athlete it means not getting sluggish and drained. It's not yet clear how that happens, but it may be due to selective action at the muscle to in-



crease glycogen synthesis.

Of all the proposed so-called insulin mimickers and insulin cofactors, pinitol is the one with the most promise.

Maltose-and-dextrose blend, 24 grams. Dextrose is a sugar found in nearly every powder, bar and candy, and like other sugars it has four calories per gram. It's used in creatine delivery to prompt an insulin spike, which increases nutrient uptake by the cells. Using a lot of it will give a greater insulin spike, but it will also give you a big tummy. If you want to look eight months pregnant, go for the high-dextrose-content formulas. What's more, if you take a large amount of sugar at once, the sugar will go to your liver for storage rather than the muscle (Charrington, A., Vanderbilt University Medical Center). It has to do with the amount of sugar in the portal blood, the blood that delivers nutrients from the intestines to the liver, compared to what's in the peripheral bloodstream, the circulating blood supply to the body. Too much sugar, and it doesn't do the job.

Maltose is a type of sugar, a disaccharide, that has a higher glycemic index than dextrose and is well tolerated. It's not so potent a signal for insulin release that it will trigger hypo-

While the researchers found that the additional protein didn't enhance physical performance, it did have an interesting side effect in that the men who ate the high-protein diet acquired increased body protein stores and muscle mass.

Studies have shown that eating smaller meals throughout the day can increase protein synthesis, and a recent French study showed the importance of combining whey protein for fast, anabolic reactions and casein for a slower, anticatabolic trickle-feed effect.

glycemia, but it will aid in promoting the insulin signal without adding a large number of carbs. Consequently, the sugar blend is designed to promote an adequate insulin response to enhance the cell volume effect of the nutrients without making you fat. A maltose-and-dextrose blend of 24 grams, added to the two grams of D-ribose, provides 26 grams of sugar, stimulating insulin release.

Chromium GTF, 100 micrograms. Chromium doesn't do much and is really too weak to be considered as a single-ingredient product. Whenever insulin function is a factor in product action, however, there's a place for chromium. Chromium picolinate has received all of the attention in the supplement market, and it's given in doses as high as 500 micrograms (that's micrograms, not milligrams). High doses may have potential for adverse long-term effects. Picolinate may be fine, or it may be linked to negative cellular events. As it may not be entirely safe, the picolinate form may not be worth the risk.

Chromium GTF acts as a co-factor to insulin. That means the insulin is actually doing the work, but the chromium GTF performs a function or functions that allow insulin to do its job better.

Proprietary blend of amino acids, dipeptides and tripeptides. Dipeptides and tripeptides are carried across the intestinal membrane by separate carriers, which allows for a greater concentration of amino acids to reach the bloodstream. It doesn't take a great concentration of certain amino acids to cause a muscle cell to swell, and the volumizing effect is enhanced in the presence of insulin. Now you can see why the pinitol, sugars and chromium GTF play such vital roles in the formula.

With the above ingredients in the formula, AnaVol-R is designed to promote cell volume increases to support an anabolic phase of metabolism. It's designed to allow—even force—your body to grow.

If you'd like to try AnaVol-R, you can do it now at a special low price. A one-month supply retails for \$99.95, but you can get two big canisters for that price—if you agree to give us your feedback. That's right, it's a buy-one-get-one-free deal, and all you have to do to get it is fill out a questionnaire after you use the product.

In addition, bodybuilders know that protein contributes to muscle-cell volume, and studies have proved that. In one study that was published in the *American Journal of Clinical Nutrition* (28:29-35; 1975), two groups of men trained hard, performing "heavy physical activity." One group took in 100 grams of protein per day, and the other took in 197 grams, almost double the amount of the first group. The study lasted 40 days.

While the researchers found that the additional protein didn't en-

hance physical performance, it did have an interesting side effect in that the men who ate the high-protein diet acquired increased body protein stores and muscle mass. That's right, they gained more muscle—and isn't that what bodybuilders are after?

Other studies have shown that eating smaller meals throughout the day can increase protein synthesis, and a recent French study showed the importance of combining whey protein for fast, anabolic reactions and casein for a slower, anticatabolic trickle-feed effect. There are also studies on glutamine that have shown how important it is to recovery and cell volumization.

The premier protein powder that embraces all of those findings is Muscle-Link's Pro-Fusion. It's a perfect blend of whey, micellar casein and egg proteins with a whopping 10 grams of glutamine peptides per serving. With two scoops you get 45 grams of protein and 220 calories, so you can use a full serving in water as a stand-alone protein feeding or add half a serving mixed in water to solid-food meals for an extra protein blast to feed your muscles and swell those cells. (Just don't miss meals, or you risk losing muscle.)

Pro-Fusion retails for \$49.95 for one two-pound canister, but you can get two big canisters for that price if you call now and agree to give us feedback for a future feature in *IRONMAN*. We'll even throw in an *IRONMAN* Training & Research Center T-shirt—don't forget to give us your size—and we'll rush you your supplements to test.

Call 1-800-447-0008 and ask for the *IM* Research Team Cell-XL Special, and you get the following:

- A two-month supply of AnaVol-R.
 - Two big canisters of Pro-Fusion protein.
 - An *IRONMAN* Training & Research Center T-shirt.
- All for only \$149.95 (you save more than \$150).

That's a \$300 value, but you get it all for only \$149.95 plus shipping and handling—half price. To put it more plainly, you save more than \$150 for a two-month supply of two of the best muscle-cell-volumizing supplements available, and all you have to do is give us feedback on the products and before and after pictures to use in an upcoming feature. If you don't feel particularly photogenic, you can skip the photos, but we do want extensive feedback and comments on the questionnaire after you make your spectacular progress. (By the way, before and after photos are a big plus, so send them if you can.)

Call 1-800-447-0008 right away to take advantage of the *IM* Research Team Cell-XL Special. Ask for it when you call. Join the Team, test hot new supplements and grow. Call now!

Ephedrine and caffeine help the body burn more fatty acids during activity by increasing fat mobilization. Guggul supplements help optimize thyroid output as your calories decrease so you avoid those frustrating plateaus.

With Adipokinetix you can lose fat, preserve muscle tissue and at the same time increase your sex drive. Yohimbine vastly improves the effectiveness of the norephedrine and the caffeine by allowing the increased adrenergic hormones to do their job.

IRONMAN Research Team 4: Fat-Burning Special

If you're a serious bodybuilder, you're always trying to pack on mass, but when the weather starts to heat up, you also begin thinking about getting lean. You don't want to get caught with your abs covered in a shroud of definition-blurring fat.

You start the fat-burning process by gradually paring back your calories. After a few weeks of that you begin supplementing with some proven fat burners and metabolic stimulators, and then you're on your way to a ripped physique, able to reveal sliced and diced abs at the pool, lake or beach on the very first warm day.

The most popular fat-melting stack is an ephedrine-caffeine compound taken with a guggulsterone supplement. The ephedrine and caffeine help the body burn more fatty acids during activity by increasing fat mobilization. Guggul supplements help optimize thyroid output as your calories decrease so you avoid those frustrating plateaus—the ones that don't seem to budge no matter what drastic aerobic or calorie-cutting actions you take. An EC compound with a guggul supplement gives you a double-whammy fat-melting effect.

The top-of-the-line EC compound is Syntrax Innovations' Adipokinetix, although it's really an NC stack, as it contains norephedrine. It's been a best-seller in the bodybuilding world, has crossed over into Joe and Josephine Public's world and has received rave reviews from almost everyone who's tried it. Derek Cornelius, Adipo's developer, explains how it works:

"Adipokinetix is a supplement that mobilizes and burns fat tissue without sacrificing muscle and organ tissue. You should be familiar with the ECA stack—a combination of ephedrine, caffeine and aspirin. Adipokinetix is similar to ECA but is a vast improvement. It takes fat mobilization and burning to a new level. Adipokinetix contains precise ratios of 1R,2S norephedrine HCl, caffeine, yohimbine HCl and now 50 milligrams of theophylline. The aspirin is left out because some people are sensitive to it. Furthermore, aspirin is cheap, easy to get and can be easily added to the stack if you can tolerate it.

"The first two compounds—1R,2S norephedrine and caffeine—work together in much the same way ephedrine and caffeine work. The difference is that studies have shown norephedrine to be the most potent and most thermogenic of the ephedrine alkaloids. Norephedrine also lacks some of the central-nervous-system-stimulating effects of ephedrine. In practical terms that means an individual will still feel a little wired but not nearly as much as he or she will feel with ephedrine. Another plus for norephedrine is that it doesn't have the negative associations that ephedrine has—there are no Food and Drug Administration restrictions and no negative publicity. In the coming years norephedrine will definitely be the compound of choice for easy, effective weight loss—instead of the ECA stack, you'll hear about the

NCA stack.

"Norephedrine and caffeine work synergistically to drastically increase the body's production of adrenaline and noradrenaline—the adrenergic hormones—which bind to the adrenergic receptors. There are a number of different adrenergic receptors: the alpha sub 1, alpha sub 2, beta sub 1, beta sub 2 and beta sub 3. We are mainly interested in the alpha-sub-2, beta-sub-2 and beta-sub-3 receptors—for they're the ones that mainly affect fat loss and mobilization.

"Among other things, the beta-sub-2 and beta-sub-3 receptors are responsible for the mobilization and burning of adipose tissue; so they are the receptors that you want to stimulate, for they ultimately affect fat loss in a positive way. Another positive benefit of stimulating the beta-sub-2 receptors is an anticatabolic effect on proteinaceous tissues. Thus, you simultaneously lose fat without sacrificing much or any muscle tissue.

"The other receptor that we're interested in is the alpha-sub-2 receptor. Studies have shown that it blocks the mobilization of adipose tissue. In terms of fat loss it's the bad guy. In fact, it's the receptor that causes women to have a harder time losing adipose tissue—especially in their lower bodies. Women have many more alpha-sub-2 receptors than men, and they have an even greater number in their lower bodies. To combat those nasty receptors, we need a compound that's naturally occurring, easy to get, potent, lacking negative side effects and able to block them. Yohimbine is the answer.

"Yohimbine does all of the above with an added bonus—it's a proven aphrodisiac. Thus, with Adipokinetix you can lose fat, preserve muscle tissue and at the same time increase your sex drive—regardless of your gender. Both men and women benefit. Yohimbine vastly improves the effectiveness of the norephedrine and the caffeine by allowing the increased adrenergic hormones to do their job. Basically, it cripples your body's negative feedback loop for maintaining your bodyfat.

When you ramp up your fat-burning with Adipo, you also want to optimize your thyroid output to prevent a stagnant metabolism, and that's where guggulsterones come in. Muscle-Link's Thyro Stak is a potent guggul compound that has also proven itself in the bodybuilding realm, and it's no doubt so effective because it includes a number of other compounds that synergize with the guggul extract. Here's an explanation of how it works from Daniel Gwartney, M.D.:

"Thyro Stak includes five ingredients that have been shown to support or enhance thyroid activity even in low-calorie environments.

"The main ingredient is an herb that has received little attention in Western medicine, though it's been used in Ayurvedic medicine for many centuries. Commiphora mukul contains a class of active compounds known as guggulsterones, and, while there isn't a great deal of published research on the compounds, what there is indicates that guggulsterones, specifically guggulsterones Z and E, have thyroid-

Diet is very important, specifically eating six meals a day with protein at each feeding. That keeps your blood sugar level on an even keel, feeds your muscle growth throughout the day and wards off cravings.

Certain fats have the ability to promote growth by significantly reducing muscle breakdown. Research has discovered that people need a combination of saturated, mono-unsaturated and polyunsaturated fats, especially athletes.

stimulating activity. Subjects in those studies showed an increase in thyroid hormone levels and an increase in the conversion of T4 [less potent thyroid hormone] to T3 [more potent thyroid hormone]. They showed lower cholesterol and blood triglyceride levels as well, further indicating increased thyroid activity.

“Thyro Stak also contains phosphates, which are found in such high-energy compounds as ATP and phosphocreatine. Thyroid activity is closely linked to the amount of energy you have, so it’s a good idea for everyone to take an ample amount of phosphates daily. Numerous studies have shown the effect of phosphate supplementation on metabolic rate. Of particular interest is a study published in 1996, which demonstrated that phosphates can prevent a decrease in T3 and stimulate an increase in resting metabolism in subjects who are on low-energy diets. That, in addition to phosphates’ positive effects on creatine storage, buffering lactic acid and increasing ATP, firmly establishes the value of including phosphates in Thyro Stak.

“The product contains niacin, selenium and magnesium. Niacin plays a role in supporting the co-factors necessary for energy production, such as NAD(H) and NADP(H). More than 200 enzymes require NAD and NADP. NAD is involved in energy production, while NADP(H) is used in a variety of processes, including fatty acid synthesis, glutamate oxidation and antioxidant activity. Niacin has also been shown to decrease cholesterol levels. Some people are sensitive to the flushing effect of high doses of niacin, but the effect is short-lived, and it’s possible to build up a tolerance with continued usage.

“Selenium is a mineral that has received a great deal of attention in recent years. Selenium appears to have a major regulatory impact on the enzyme 5’-deiodinase, which converts T4 to T3. Low levels of selenium can impair thyroid conversion—but excess selenium also has a negative effect on thyroid conversion.

“Magnesium is present in more than 300 identified enzymatic reactions. It’s involved in glycolysis, the Krebs cycle and creatine phosphate production, among others. Magnesium even has a role in protein synthesis. Subjects in a 1992 study showed increases in strength and lean body mass after a few weeks of increasing their magnesium intake.”

Of course, you can’t just swallow a few capsules and expect to have all your bodyfat melt away like magic. You also have to train hard—the more muscle you have, the more calories your body burns—and you have to eat right.

Diet is very important, specifically eating six meals a day with protein at each feeding. That keeps your blood sugar level on an even keel, feeds your muscle growth throughout the day and wards off cravings. It’s very difficult to eat six solid-food meals every 24 hours, but that’s the very reason meal replacements were created. One of the best is Muscle-Link’s Muscle Meals. Here’s why.

Fusion of micellar casein, whey and egg proteins. For obvious reasons mother’s milk provides all the essentials for rapid growth, and it’s

no accident that it contains approximately equal amounts of casein and whey protein. Fast-growing infants, who instinctively eat at least six times a day, need both slow and fast absorption of amino acids. Muscle Meals provides a perfect balance of micellar casein and whey, along with egg protein, so you get both anabolic and anticatabolic actions.

Glutamine peptides. This is the most potent form of glutamine, one of the key muscle-building amino acids. It’s up to 10 times more effective than L-glutamine supplements due to better absorption. Why do bodybuilders need extra glutamine? Experiments reveal that the entry of glutamine into the muscle cell can increase its volume, which directly translates into growth. Also, glutamine makes up two-thirds of the muscles’ free amino acid content and rapidly exits the cells after a workout. Therefore, bodybuilders should keep glutamine intake high to prevent catabolism and promote anabolism, and Muscle Meals makes it much easier with its 10 grams of glutamine peptides per serving. Glutamine has also been linked to growth hormone release.

Anticatabolic fats. Certain fats have the ability to promote growth by significantly reducing muscle breakdown. Research has discovered that people need a combination of saturated, monounsaturated and polyunsaturated fats, especially athletes, as those fats have been shown to promote growth hormone release, strengthen the cardiovascular system, enhance bodyfat metabolism and promote testosterone production. Muscle Meals has the perfect balance of essential fats. It also includes medium-chain triglycerides, which serve as an alternate energy source without fat storage.

Potassium and magnesium. The two minerals are essential to bodybuilders, and a number of scientific studies verify that taking them increases lean muscle mass rapidly. Remember, the more muscle you have, the more calories your body burns.

No aspartame. Headaches and other health-related maladies have been linked to aspartame, which is why many supplement manufacturers are switching to sucralose as a sweetener. Sucralose was recently approved by the United States Food and Drug Administration (FDA), and by the Joint FAO/WHO Expert Committee on Food Additives (JECFA). It has been consumed by millions of people internationally since 1991 and is backed by more than 100 scientific studies conducted over a 20-year period, which have conclusively determined that sucralose is safe. It’s approximately 600 times sweeter than sugar, and that means almost zero calories in a serving and very little, if any, insulin response.

Now you have a better understanding of how Adipokinetix, Thyro Stak and Muscle Meals can work together and form the core of your fat-burning-supplement arsenal. To make it easier for you to experience that synergistic combination, call 1-800-447-0008 and ask for the *IM* Research Team Fat-Burning Special. It’s an unbelievable deal. Here’s what you’ll get:

While bodybuilders know about testosterone’s ability to make people frisky, they use it to jack up muscle mass, aggression and strength. Testosterone can make you an animal in the gym and help turn your body into a lean, mean mass machine.

The best pro-hormone available in cyclodextrin form is 4-androstenediol. It's a direct precursor to and metabolite of testosterone; however, it converts much faster and more efficiently than other pro-hormones.

- Four 20-packet boxes of Muscle Meals (a \$240 value).
 - Three 180-capsule bottles of Adipokinetix (a \$105 value).
 - Three 180-capsule bottles of Thyro Stak (a \$120 value).
 - An *IRONMAN* Training & Research Center T-shirt.
- All for only \$229.95 (you save more than \$235).

Add it all up and the retail value comes to more than \$465, but you get it all for only \$229.95 plus shipping and handling. That's more than half off. In other words, you save more than \$235 for a three-month supply of three of the best fat-burning/muscle-sparing supplements available—and all you have to do is give us feedback on the products via the questionnaire that comes with your order and before and after pictures to use in an upcoming feature. If you don't feel particularly photogenic, you can skip the photos, but we do want extensive feedback and comments after you make your spectacular progress, with your abs resembling carved chunks of granite. (Before and after photos are a big plus, however, so get them if you can.)

Call 1-800-447-0008 immediately and ask for the *IM* Research Team Fat-Burning Special. We'll even throw in an *IRONMAN* Training & Research Team T-shirt—don't forget to give us your size—and we'll rush you your supplements to test. Join the Team, test hot new supplements and get your physique ripped and ready. Don't be caught with your abs covered by a blanket of fat. Call now!

IRONMAN Research Team 5: T-Boosting Special

When you think about anabolic hormones, testosterone should be first on the list. It's been injected, taken orally and even taken through a patch delivery system, usually to increase libido. While bodybuilders know about the hormone's ability to make people frisky, they use it to jack up muscle mass, aggression and strength. Testosterone can make you an animal in the gym and help turn your body into a lean, mean mass machine.

Synthetic testosterone has been banned by most athletic organizations, however, and it can have some undesirable side effect, like hair loss and acne. It's much safer to coax your testosterone higher with supplements like tribulus terrestris, essential fatty acids and pro-hormones, specifically the new sublingual cyclodextrin complexes that are more effective and safer at lower dosages than the encapsulated oral pro-hormones of the past.

The Latest, Greatest Pro-Hormone Innovation

Yes, pro-hormones are chemical compounds, but with the new sub-

lingual cyclodextrins, the pro-hormone enters your bloodstream immediately via the tissues in your mouth, bypassing the liver, so you can get optimal effects from small doses—only 25 milligrams taken two to three times a day. Low dosage is one reason side effects are few and far between with the sublingual cyclo; the fact that they bypass the liver is another. Oral pro-hormones, on the other hand, disintegrate in the stomach and then make their way to the liver, where they're almost completely deactivated—most estimates suggest only 5 percent of an oral dose remains active. As the liver is also the place where a lot of the aromatization enzymes reside, the possibility of side effects is much higher with encapsulated oral pro-hormones. Fortunately, the new sublingual cyclodextrins and their direct-to-bloodstream delivery bypass that problem.

The best pro-hormone available in cyclodextrin form is 4-androstenediol. It's a direct precursor to and metabolite of testosterone; however, it converts much faster and more efficiently than other pro-hormones. Here's how Patrick Arnold, the scientist behind so many pro-hormone innovations and the president of LPJ Research, explains cyclodextrin technology:

Cyclodextrins are a form of carbohydrate, or sugar, molecules linked together. They're formed by an enzymatic synthesis that starts with starch. The enzymes, which are called transglycosidases, are derived from bacteria, and they couple the starch molecules together to form a truncated conical molecular structure with a hollow cavity inside. Each cyclodextrin molecule looks like a cheerleader's megaphone.

What make the cyclodextrin molecules so interesting to us—and to the drug industry in general—are their unique properties. The cyclodextrin "cone" is just about the perfect shape and volume to fit a steroid molecule inside. Chemically, the inside of the cone is nonpolar, meaning fatty, or oil-like, which allows it to latch onto the steroid molecule. The outside of the cyclodextrin cone, however, is polar, meaning waterlike.

When a steroid molecule and a cyclodextrin molecule link up, they form a 1-to-1 complex. Think of the cyclodextrin as a molecular "condom" for steroids. The remarkable thing about it is that it's water-soluble. So, while steroids themselves won't dissolve in water, a cyclodextrin-and-steroid complex will, which significantly increases its bioavailability over standard oral administrations.

Cyclo-Diol by Ergopharm is the number-one cyclodextrin pro-hormone on the market. Studies have shown that cyclodextrin complexes are the future of pro-hormones, safer and more effective than any other form.

Tribulus Synergy

Bodybuilders have been using the herb tribulus terrestris for years as a natural anabolic. Trib can stimulate luteinizing hormone (LH) pro-

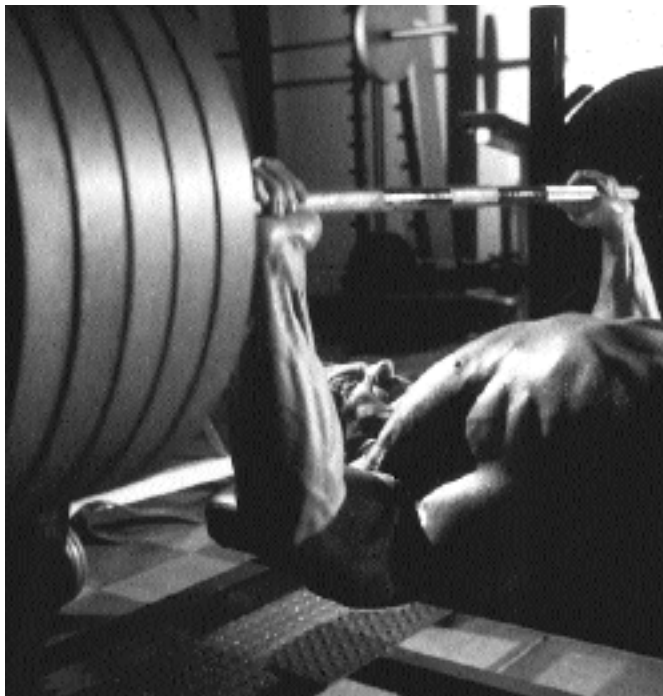
Research conducted by Balco Labs on strength athletes shows that ZMA's precise combination of zinc, magnesium and vitamin B6 can increase total and free testosterone levels by 30 percent.

The results of the double-blind study showed that the group that got oral magnesium supplements had significantly greater strength gains than the control group. Other studies show that serum magnesium levels may be reduced in response to strength training.

duction from the anterior pituitary gland, which in turn stimulates testosterone production. Clinical studies have shown that trib can increase free testosterone levels by as much as 40 percent.

The newest trib supplement on the market is Muscle-Link's TMZ, but it's far more than just tribulus. It also contains a number of other synergistic compounds that can help boost testosterone. The following is an explanation of those other ingredients from Rehan Jalali and Sofia Ghani, Pharm.D.:

Muira puama. This is an herb that's also known as potency wood. It's native to Brazil and has been used as a powerful aphrodisiac and nerve stimulant for many years. A French study done at the Institute of Sexology in Paris under the direction of Dr. Jacques Waynberg, one of the world's foremost authorities on sexual dysfunction, involved approximately 262 patients who complained of impotence and lack of libido. The results showed that muira puama supplementation had a tremendous positive effect in the majority of the subjects. It seemed to correct impotence and improve sex drive through an unknown mechanism, but that effect may be due to increases in testosterone levels or,



possibly, a positive effect on nitric oxide (NO) levels, which would improve erectile function.

ZMA™. This is an exciting new vitamin-and-mineral combination. It's a special combination of zinc, magnesium and vitamin B6. The zinc is specifically formulated as zinc aspartate and zinc mono L-methionine, which makes it incredibly bioavailable because of the two forms of chelates. The magnesium is also found in a chelated form bound to aspartate, which makes it very bioavailable as well. In fact, the magnesium and zinc are bound together to the aspartate, which can also, chemically speaking, enhance absorption, meaning you get more of their benefits.

ZMA is the creation of Balco Labs and Executive Director Victor Conte, who's been studying the effects of minerals and trace elements for more than 15 years. Research conducted by Balco Labs on strength athletes shows that ZMA's precise combination of zinc, magnesium and vitamin B6 can increase total and free testosterone levels by 30 percent. That study, which has been accepted for publication in the *Sports Medicine, Training, and Rehabilitation Journal*, showed that nightly supplementation with ZMA increased strength and power as well.

A 1996 study titled "Zinc Status and Serum Testosterone Levels of Healthy Adults" by Ananda Prasad, M.D., Ph.D., that was published in the journal *Nutrition* showed that taking 30 milligrams of supplemental zinc daily doubled the testosterone levels in six months of healthy men who were experiencing moderate zinc deficiency. Now, that's a testosterone booster! In addition, zinc has been shown in several research studies to increase growth hormone and insulinlike growth factor 1 (IGF-1) levels, and it has antioxidant activity that helps support the immune system.

Magnesium is a macromineral that's involved in more than 300 enzymatic reactions in the body, including glycolysis, the Krebs cycle, creatine phosphate formation, nucleic acid synthesis, amino acid activation, cardiac- and smooth-muscle contractability, cyclic AMP formation and, most important for strength athletes, protein synthesis. Magnesium is a versatile mineral that has some major implications for athletes, and it's been studied quite extensively. It competes with phosphorous and calcium for absorption in the intestinal mucosa, which is the reason you don't want to take magnesium together with calcium and phosphorous.

Magnesium is also a cofactor of the enzyme creatine kinase, which converts creatine into creatine phosphate, or phosphocreatine, the storage form of creatine. Since creatine monohydrate supplements are extremely popular and have been proven effective, magnesium may be an important mineral in helping to optimize creatine function.

As for magnesium's key role in protein biosynthesis, it's necessary for the activation of amino acids and helps "make" proteins. In other words, protein synthesis depends on optimal magnesium concentra-

Protein synthesis depends on optimal magnesium concentrations. It's hypothesized that low magnesium levels may negatively affect protein metabolism and may result in diminished strength gains in a structured workout regimen.

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tions. It's hypothesized that low magnesium levels may negatively affect protein metabolism and may result in diminished strength gains in a structured workout regimen.

Increased losses of magnesium from the body have been seen during and after exercise, and athletes do seem to have magnesium deficiencies. One 1992 study published in the *Journal of the American College of Nutrition* titled "Effect of Magnesium Supplementation on Strength Training in Humans," studied the effects of a dietary magnesium supplement on strength development in 26 untrained subjects during a seven-week strength-training program. The results of the double-blind study showed that the group that got oral magnesium supplements had significantly greater strength gains than the control group. Other studies show that serum magnesium levels may be reduced in response to strength training, and it's been noted that maximal contraction of the quadriceps correlates positively to serum magnesium status.

The final ingredient in the ZMA formula is vitamin B6, which is also known as pyridoxine and has some major influences on protein synthesis. The coenzyme form of the vitamin is associated with a vast number of enzymes, the majority of which are a part of amino acid metabolism. It's necessary in glycogen catabolism to unlock carbohydrate energy, and vitamin B6 has been shown to diminish the actions of certain steroids such as cortisol.

TMZ is obviously a state-of-the-art natural testosterone booster, one that can complement any pro-hormone regimen.

Essential Anabolic Fats

The new line on fats is that there are good ones and bad ones. Saturated fat, for example, has been shown to increase cardiovascular disease, and it's the primary reason dietary fat has gotten such a bad rep. Good fats, however, include omega-3 and omega-6 fatty acids, and they can do wonders for health, athletic performance and muscle growth. Because of the popularity of lowfat diets, however, most people are deficient in them, especially athletes.

Getting a balance of the essential fatty acids (EFAs) can improve the action of insulin, decrease muscle breakdown, increase growth hormone secretion and optimize hormone production. In fact, noted bodybuilding author and researcher Dan Duchaine has said that EFAs are the most anabolic legal supplement available.

The new Omega Stak from Muscle-Link contains a perfect balance of the essential fats. While the EFAs in this product used to come from hemp oil, that's no longer the case. Omega Stak has been reformulated, and now all the EFAs are derived from sources like flaxseed oil, among others. That means there's no more threat of failing a drug test. It's completely safe and legal and still has a perfect balance of EFAs.

Using Omega Stak along with Cyclo-Diol, the best cyclodextrin pro-hormone, and TMZ, the new tribulus-zinc-magnesium-muira puama complex, should give you a blast of muscle size and strength that's like nothing you've never experienced. All three ingredients of this synergistic testosterone-boosting combo are available at health food stores or by mail order from various companies, but we want to make it easier for you to try it. We're offering all three in the *IM* Research Team T-Boosting Special. Here's what you get:

Cyclo-Diol, two bottles, 60 25-milligram lozenges in each, a \$99.90 value.

TMZ, two bottles, 120 capsules in each, a \$79.90 value.

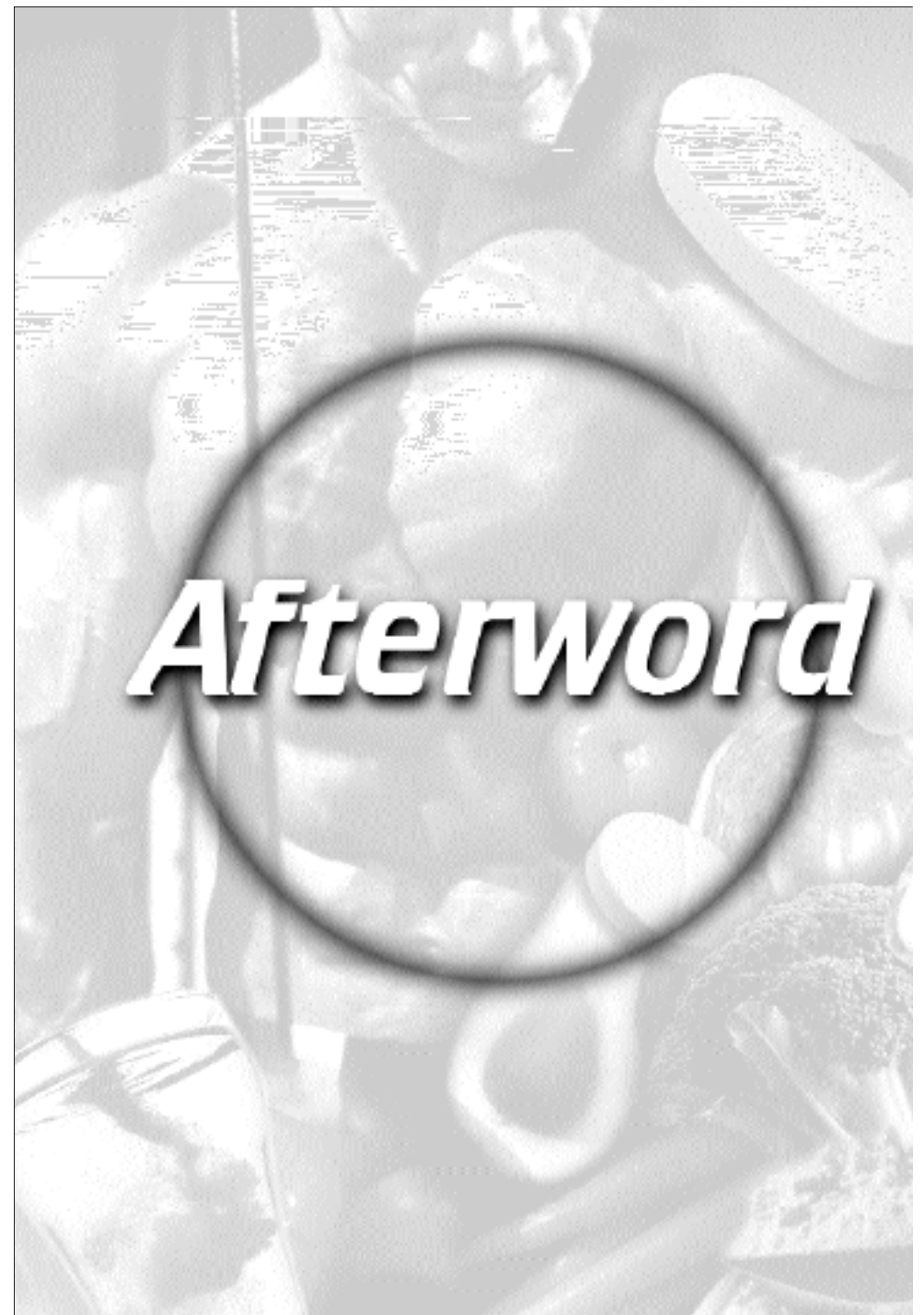
Omega Stak, two bottles, 270 1,000-milligram capsules in each, a \$79.90 value.

All for only \$149.95 (you save \$110).

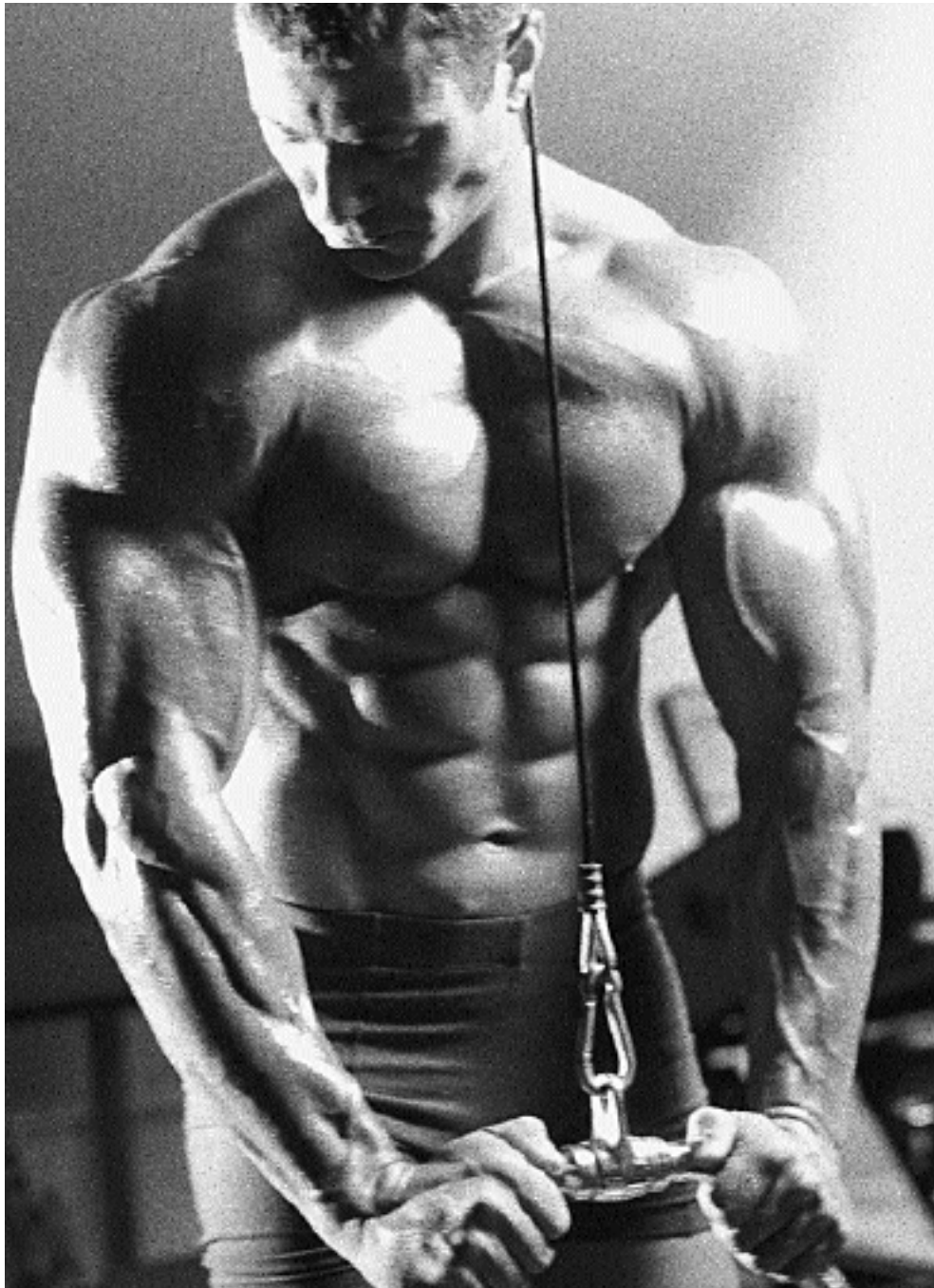
Add it all up and it comes to about \$260, but if you call 1-800-447-0008 and ask for the *IRONMAN* Research Team T-Boosting Special, you can get all of the above for only \$149.95, a savings of \$110. Call now and take advantage of the *IM* Research Team T-Boosting Special. We'll even throw in an *IRONMAN* Training & Research Team T-shirt—so don't forget to give us your size. We'll rush your supplements to you to test so you can experience firsthand why testosterone is the king of the anabolic hormones. Join the Team and get ready to grow as you've never grown before.

Noted bodybuilding author and researcher Dan Duchaine has said that EFAs are the most anabolic legal supplement available.





Afterword



Training for Muscle Size

by Steve Holman

As John Balik said in the Introduction, “Sweat is the only true magic bullet.” In other words, no supplement program is going to build appreciable muscle size without some serious work in the gym—and that work should be specific in a number of areas to trigger the fastest hypertrophic response possible.

Here are the growth mechanisms that are most important in changing the size of the muscle structures. The training routine that follows incorporates all of them into a scientific training strategy that will help you maximize your results and get the most from your supplement and nutrition schedules.

Capillarization

Scientists don’t really know how much a venous network expansion in each muscle contributes to overall size; however, they do know that it contributes not only to the sheer size of a muscle but also to its function. So a pump can build more capillaries in a muscle, which in turn can give it more girth and make it more efficient at removing waste products and pumping in needed growth nutrients and fuel, such as creatine. On the surface, new vascularity will be a sure indication to everyone that you’re in phenomenal shape. You’ll be amazed at the way a few new veins running down your forearms and crisscrossing your quads can inspire such comments as, “Man, you’re looking a helluva lot bigger these days”—even if you haven’t gained an ounce.

GH Release

Studies have shown that changing the pH of the blood due to muscle burn and lactic acid release can create intense surges in growth hormone. European researcher Michael Gündill and American researcher Jerry Brainum have both written about that phenomenon in *IRONMAN*. Supersetting two exercises for the same bodypart is one of the best

ways to achieve muscle burn and set the stage for a significant increase in GH release.

Fiber Recruitment

There are a number of fiber types in every muscle. To get the maximum growth stimulation, you must achieve hypertrophy in as many fibers as possible, even the slow-twitch, aerobic fibers. (By the way, growth hormone has been shown to stimulate growth in those fibers as well as the anaerobic fibers.) That means you need a variety of rep ranges to attack the various fiber types. Pyramiding is one way. For your first set you use a weight that allows around 10 strict reps, and you add weight at each subsequent set so that the reps decrease; for example, eight, six, three. You can get a similar effect with supersets.

When you superset two exercises, you essentially get the benefits of a low-rep set with the first exercise—you should hit failure at around rep seven—and a high-rep set as you finish the second, which essentially extends the first set with medium-intensity reps that build to a high-intensity climax as you hit failure at around rep six or seven. What you do in that short time is attack the lower-rep type 2 fibers with the first exercise and then exhaust the higher-rep type 2s with the second set. Plus, you no doubt involve some type 1 (aerobic) fibers as well. That’s essential training efficiency at its best.

You can get even more fiber recruitment if you use stretch-position movements as one of the exercises in your superset. When a muscle is put in an elongated state prior to contracting, it can trigger an emergency neuromuscular response. The body senses danger—a possibility that muscle damage may occur—so it recruits more fibers to contract in order to prevent injury. If you do decide to use stretch-position exercises as part of a superset, it’s probably best to make them the first exercise, as doing them second, when the target muscle is already fatigued, can cause you to have less control, so there’s more potential for injury.

Christian Borczyk

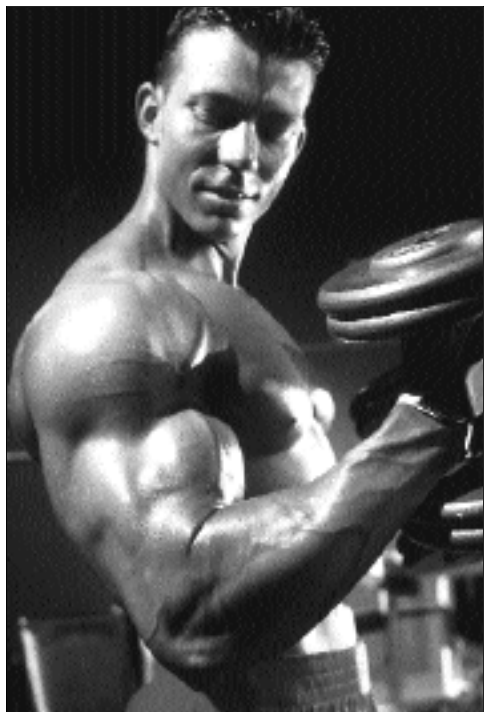
Studies have shown that hanging the pH of the blood due to muscle burn and lactic acid release can create intense surges in growth hormone. Supersetting two exercises for the same bodypart is one of the best ways to achieve muscle burn and set the stage for a significant increase in GH release.

Incidentally, Gündill recommends stretching and stretch-position movements because they “increase the muscle’s sensitivity to testosterone by increasing the number of androgen receptors inside the stretched muscle.” Remember, you’re looking for efficiency of effort, so you don’t want to waste time and deplete too much of your recovery ability doing set after endless set. Stimulating the target muscles’ androgen receptors via stretch exercises while also training the gamut of muscle fibers with resistance can be a key mechanism in the efficient-muscle-building equation.

In the routine that follows you’ll use stretch-position exercises as the first part of a superset. Once you execute a perfect set of a stretch exercise, you move immediately to a second exercise for the target bodypart. For that you choose a contracted-position movement to squeeze out the last bit of effort from the target muscle with maximum contraction. This is known as Isolation Aftershock training and is more thoroughly discussed in the book *Compound Aftershock*.

Notice in the routine that you begin with a compound, or midrange, movement for each bodypart, where applicable, pyramiding the weight. That’s one of the best ways to train the mass of the muscle fibers for big size gains. Once you do that, you follow up with a stretch-position exercise, supersetting it with a contracted-position movement. That finishes off the muscle and triggers many of the growth mechanisms explained earlier. With that strategy you not only maximize many of the aforementioned growth mechanisms, but you

also train each muscle through its full range of motion via Positions-of-Flexions training, working the midrange, stretch and contracted positions for full, complete development. For those reasons the following is one of the best routines for building new muscle size and strength. Use it with a scientific supplementation and diet program similar to the one in this book, and you’ll make outstanding progress—perhaps some of the best gains of your life.



Muscle-Size-Building Training Tips

- Go easy your first week. Use the first week on your new GH-boosting routine as a break-in. Don’t go to failure on any exercise. Concentrate on perfecting your form, and take it very easy on your stretch-position movements, as they can induce extreme soreness.
- After week 1 go to failure, the point at which another rep is impossible, on all work sets.
- Your rep cadence should be two seconds up and two seconds down on all exercises. Think “one-thousand-one, one-thousand-two.”
- The workouts listed do not include warmups sets. Do one to two warmup sets with 50 percent of your work weight on each exercise you pyramid. A warm muscle contracts more efficiently than a cold muscle, so if you’re training in a chilly room, make sure you do two warmup sets.
- Whenever you can get 10 reps on the first work set of your power pyramid, up the weight on all sets at your next workout.
- Go to at least positive failure on all of your sets other than warmups. If you start losing your enthusiasm, try a moderate-intensity week—don’t go to failure for four straight workouts. Then during the following week go back to all-out intensity
- Rest one to 1 1/2 minutes between sets.
- Do not rest between exercises listed in the Aftershock Superset; however, rest 1 1/2 minutes after you complete both exercises in the superset.
- Don’t overtrain. If you feel the workouts listed are too long, you can split your body over three days instead of two and train on a three-days-on/one-off program. For example, workout 1: chest, delts, triceps; workout 2: quads, hamstrings, calves, abs; workout 3: back, biceps, forearms. You may also want to include two Aftershock Supersets instead of one for lagging bodyparts. Extreme hardgainers can use the above split but train only on Monday, Wednesday and Friday, with weekends off—working each bodypart once a week.
- After eight weeks on this routine, start a new program. (The books *Underground Mass-Boosting Methods*, *Compound Aftershock* and *Critical Mass* include quite a few appropriate programs; they’re available from Home Gym Warehouse, 1-800-447-0008, ext. 1. See the back pages of this book for more details.)

Notice in the routine that you begin with a compound, or midrange, movement for each bodypart, where applicable, pyramiding the weight. That’s one of the best ways to train the mass of the muscle fibers for big size gains.

Positions-of-Flexion Power-Pyramid/Isolation-Aftershock Program

Monday & Thursday

•Quads

Midrange: Squats* 3 x 8, 6, 3-4
 Aftershock Superset
 Stretch: Sissy squats
 or feet-forward Smith-machine squats 1 x 6-8
 Contracted: Leg extensions 1 x 6-8

•Hamstrings

Midrange: worked during squats
 Aftershock Superset
 Contracted: Lying leg curls 2 x 6-8
 Stretch: Stiff-legged deadlifts 2 x 6-8

•Calves

Midrange: worked during quad and hamstring training
 Aftershock Superset
 Stretch: Donkey calf raises 2 x 10-12
 Contracted: Standing calf raises 2 x 10-12

•Lower chest

Midrange: Barbell bench presses* 3 x 8, 6, 3-4
 Aftershock Superset
 Stretch: Flat-bench flyes 1 x 6-8
 Contracted: Cable crossovers 1 x 6-8

•Upper chest

Midrange: Incline Smith-machine presses* 2 x 8, 6
 Aftershock Superset
 Stretch: Incline flyes 1 x 6-8
 Contracted: Incline cable flyes 1 x 6-8

•Triceps

Midrange: Close-grip bench presses* 3 x 8, 6, 3-4
 Aftershock Superset
 Stretch: Overhead extensions 1 x 6-8
 Contracted: Dumbbell kickbacks 1 x 6-8

*Add weight, or pyramid, on each successive set.

Tuesday & Friday

•Lats

Midrange: Front pulldowns or chins* 3 x 8, 6, 3-4
 Aftershock Superset
 Stretch: Pullovers 1 x 6-8
 Contracted: Stiff-arm pulldowns 1 x 6-8

•Midback

Midrange: Behind-the-neck pulldowns* 2 x 8, 6
 Aftershock Superset
 Stretch: V-handle cable rows 1 x 6-8
 Contracted: Bent-over bent-arm lateral raises 1 x 6-8

•Upper traps

Stretch & Contracted: Dumbbell shrugs* 2 x 8, 6

•Delts

Midrange: Behind-the-neck presses* 3 x 8, 6, 3-4
 Aftershock Superset
 Stretch: Incline one-arm lateral raises 1 x 6-8
 Contracted: One-arm lateral raises 1 x 6-8

•Biceps

Midrange: Barbell curls* 3 x 8, 6, 3-4
 Aftershock Superset
 Stretch: Incline dumbbell curls 1 x 6-8
 Contracted: Barbell concentration curls
 or spider curls 1 x 6-8

•Abs

Midrange & Lower Contracted: Reverse crunches,
 hanging kneeups or incline kneeups 2 x 8-12
 Aftershock Superset
 Stretch: Cable crunches 1 x 10-15
 Upper Contracted: Crunches 1 x 10-15

•Soleus

Contracted: Seated calf raises 2 x 12-15

*Add weight, or pyramid, on each successive set.