Parrillo Performace Guide to Muscle, Part IV

by John Parrillo

In this bulletin we continue our superfeature on muscle and will discuss some key concepts of muscle physiology. So far we've covered muscle anatomy, ultrastructure and biochemistry, as well as control of muscle tissue by the nervous system. In final three parts of this series we'll discuss metabolic adaptations of muscle to exercise and how to design effective training strategies to achieve your goals. Please refer back to your old issues of the Parrillo Performance Press for our articles about hormones and cellular energy metabolism, as these tie in directly to muscle metabolism and physiology.

In Part 2 I introduced the concept of the motor unit: a lower motor neuron (nerve cell) in the spinal cord plus the muscle fibers that it controls. I said that a motor unit fires according to the all-or-nothing principle. That means it either fires at full power or not at all. There's no such thing as partially contracting a muscle fiber, or it contracting at medium intensity. What determines the strength of a muscular contraction is then how many motor units are recruited to fire (contract). This month we will extend this concept to the next level, and talk about patterns of muscle fiber recruitment.

Nerve impulses traveling down the axon of a motor neuron (nerve fiber) to a muscle cell travel in discrete bundles called action potentials. An action potential is an electrical signal that is carried along nerves that stimulates muscle fibers to contract by triggering the release of calcium from the sarcoplasmic reticulum. Rather than being like the continuous flow of electricity that is delivered from a battery, an action potential is a short burst or pulse of electricity, like flipping a switch on and then quickly off again. An example you may be familiar with is an EKG tracing of the heart - this is the action potential of the heart muscle.

Each action potential results in a short period of activation of the muscle fiber, and is referred to as a twitch (1). The calcium released during a twitch is sufficient to allow optimal activation of actin and myosin, and therefore maximal force development by the muscle fiber (1). However, as the contracting muscle fibers begin to pull on the tendons and "take up the slack," pumps begin pumping the calcium back into the sarcoplasmic reticulum. Thus the muscle fibers begin to relax before the muscle has time to generate maximal force on the tendons. So while a twitch stimulates a muscle fiber to contract maximally, it begins to relax before maximal force is generated by the muscle (1). If a second action potential (nerve impulse) arrives at the muscle fiber and causes another twitch before the fiber has completely relaxed, the force from the two twitches summates (adds together) to generate a greater force than from a single twitch (1). As we increase the frequency of action potentials we will decrease the rest period between twitches, and the summation of force increases (1). At a high enough frequency of stimulation the twitches fuse (that is, there's no time for the fibers to relax), and force production reaches a plateau called tetany. This is the highest force that a motor unit can produce (1).

A given muscle is composed of several different fiber types. There are many classification schemes for describing different muscle fiber types. The first approach is to classify muscle fibers according to twitch time. You've probably heard of slow-twitch versus fast-twitch fibers. A fast twitch fiber (also termed type 2) develops force rapidly and has a short twitch time (1). A slow twitch fiber (also termed type 1) develops force slowly and has a long twitch time (1). This results in different abilities to develop force and resist fatigue. Slow twitch fibers generally are fatigue resistant and have a high capacity for aerobic energy production (refer back to our series on cellular energy metabolism). This makes them ideal for low energy activities that you need to be able to sustain for a long time, like walking or standing or keeping the spine erect while sitting. Fast twitch fibers, in contrast, are easily fatigued, are relatively poor at aerobic energy production, but are able to generate tremendous forces very rapidly. Fast twitch fibers are further subdivided into two subtypes, 2a and 2b, according to differences in ATPase activity (2).

Perhaps the oldest classification scheme is based on gross appearance. In the early 1800's it was noticed that muscles range in color from deep red to pale white (2). This is most easily observed when looking at the muscles of birds, where the differences are the greatest. It is now understood that some muscles are red because they contain greater capillary density and more myoglobin (an oxygen storing molecule like the hemoglobin found in red blood cells) and mitochondria (the little furnaces inside cells where food molecules are burned to produce energy). These properties (more capillaries, myoglobin, and mitochondria) make red muscle fibers better at aerobic energy production. White muscle fibers have less myoglobin and mitochondria but more stored glycogen, making them better at anaerobic energy production. The difference is easily seen when comparing a chicken breast to a chicken thigh. A chicken breast is white meat (white muscle fibers) and a thigh is dark meat (red muscle fibers). These differences make sense if you think about it. The breast of a bird is involved in beating the wings during flight, which requires a high level of force production. The thighs, however, are involved in weight support and walking, requiring a lower level of

force production.

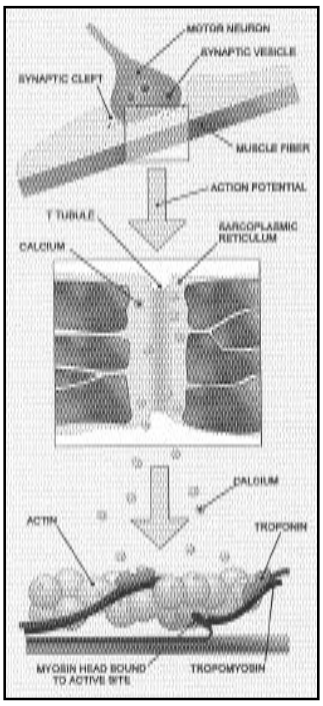
Another classification scheme is based on metabolic and histochemical (microscopic staining) properties of muscle cells. This is basically an extension of the fast twitch/slow twitch scheme, but also takes into account fuel types preferred by different fiber types. According to this scheme, fibers may be either slow oxidative (SO), fast glycolytic (FG), or fast oxidative glycolytic (FOG) (2). This scheme is based on microscopic analysis of fibers looking at various enzyme subtypes (such as subtypes of ATPases) and it gets real technical real fast. For those of you interested in greater detail, the best discussion of muscle fibers types is found in Lieber, Skeletal Muscle Structure and Function, pages 70-89 (2).

In summary: Within any given muscle different fiber types exist for performing different functions. There are many ways to classify the different fiber types. These include twitch time, muscle color, fuel sources, enzyme subtypes, fatigability, and combinations of the above. A comparison of different classification schemes is presented in the table.

In general, slow twitch (ST) fibers have a high level of aerobic endurance (3). ST fibers are thus very efficient at producing ATP from the oxidation of carbohydrate and fat (3). As long as oxygen and fuel are available, ST fibers can continue to produce ATP and thus the energy to contract. ST fibers are therefore preferentially recruited for low intensity activities like walking, jogging, or biking. Fast twitch (FT) fibers, on the other hand, are better suited for anaerobic energy production. This is largely through the conversion of stored muscle glycogen to lactic acid via glycolysis. FT motor units can generate considerably more force and power (work per unit time) than ST motor units because their rate of force production is not limited by the rate of oxygen delivery. Furthermore, FT motor units are generally larger (contain more muscle fibers) than ST units. FT motor units fatigue easily however, because they exhaust their fuel supply (and other intermediates) and build up lactic acid. When the acid level builds up too high in the cell, this shunts down the cellular enzymes that produce energy, so contraction comes to a halt. FT fibers are thus best suited for brief, high intensity activities such as sprinting. During extremely high intensity exercise, such as weight lifting, both ST and FT units are recruited to maximize force production.

Remember that force production within a muscle is increased by increasing the frequency of action potentials arriving at the muscle, and thus the frequency of twitches, and by increasing the number of motor units participating in the contraction. When only a little force is needed, only a few motor units are recruited. Recall also that FT motor units contain more fibers than ST units. Therefore, when only a little force is needed, small motor units, which are primarily the ST type, are recruited (3). As exercise intensity increases, FT type 2a (corresponding roughly to FOG type fibers) are also recruited. At maximal intensity, FT type 2b (or FG) fibers are called in.

This gets us back to the concept of intensity threshold that we talked about in the first article of our muscle series. Exercise must provide a high intensity stimulus in order to recruit all of the fibers. I like to refer to these as the "high threshold nerve pathways." It is of great importance to realize that the fast twitch fibers are the ones with the greatest potential for hypertrophy (growth). In order to stimulate these fibers to grow we must recruit them to contract, and to do that we must apply a high intensity stimulus. This is why you have to lift big weights to get big muscles. Curling 5 pound dumbbells all day will never give you big biceps.



So for maximal muscular growth a bodybuilder has to perform at least four distinct types of training: 1. Drop sets to ensure that nearly 100% of muscle fibers are recruited. 2. Heavy sets around 1-3 rep maximum to recruit the high threshold nerve pathways. 3. High intensity aerobics (around 30 minutes 3 times a week) to increase capillary supply of muscles. 4. Standard "bodybuilding sets" carried to failure at 8-10 reps. I'll explain more about this in the future, but the basic function of these is to induce local tissue trauma which serves as a stimulus for inflammation and remodeling. In the medium rep work (8-10 rep range), special attention must be paid to going to failure and to resisting the weight during the eccentric (lowering) phase of the contraction.

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Parrillo Performace Guide to Muscle, Part V

by John Parrillo

In the previous bulletin I introduced the "all or nothing" principle of muscle contraction, which states that a given motor unit either contracts maximally or not at all. I also explained the pattern of muscle fiber recruitment. For low intensity activities, such as fine finger movements or precise movement of the eyes, small motor units are recruited. Small motor units allow precise muscular control and are primarily composed of slow twitch fibers, which generate low forces and are fatigue resistant. As progressively more force is required for an activity, more fast twitch motor units are called into play. These have more muscle fibers connected to each nerve cell (that is, they are larger motor units) and are capable or generating high forces although they fatigue more easily.

In this bulletin I would like to talk about different types of muscle contraction, and why these are important in bodybuilding. Concentric muscle actions occur when a muscle is shortening. This happens when force generated within the muscle is sufficient to overcome the resistance to shortening (1). An example is the lifting phase of a biceps dumbbell curl. During this phase of contraction, action potentials are arriving at the neuromuscular junction, causing a release of the neurotransmitter acetylcholine at the synaptic cleft. This causes an influx of calcium into the muscle cell, as well as a release of calcium from the sarcoplasmic reticulum. (Review previous articles in this series in these concepts are fuzzy.) The rising calcium concentration sets off a series of events resulting in activation of the actin-myosin cross-bridges. ATP is consumed as the sarcomeres shorten, bringing the Z lines at the ends of the sarcomere closer together. Thus when a muscle fiber contracts, each of the individual sarcomeres contract, and ATP is consumed. Concentric muscle actions are really the only true muscular contractions, because contraction literally means "to shorten."

Isometric muscle actions refer to the situation where the force generated by the muscle is sufficient to exactly balance the resistance. An example is at the top of a biceps curl at the moment of peak contraction, or any time when you pause during the curl and the weight remains stationary. "Isometric" means "the same length," and thus describes any time a muscle is working but is not changing in length. Eccentric muscle actions refer to situations when the muscle is generating force but that force is less than the resistance on the muscle. An example is the lowering phase of a biceps curl. Here, the muscle is still working and generating force, but the muscle is actually getting longer. Gravity is the force pulling the dumbbell downward, and this force is transmitted to the forearm and then to the biceps tendon. If this force is greater than the internal force generated by the biceps muscle, then the muscle will lengthen instead of contracting, even though it is still working and generating force. "Isokinetic" means "the same velocity" and describes muscle actions that occur at constant velocity. An isokinetic contraction is simply a concentric muscle action that occurs at constant velocity.

Concentric muscle actions occur when a muscle is shortening. This happens when force generated within the muscle is sufficient to overcome the resistance to shortening. An example is the lifting phase of a biceps dumbbell curl.

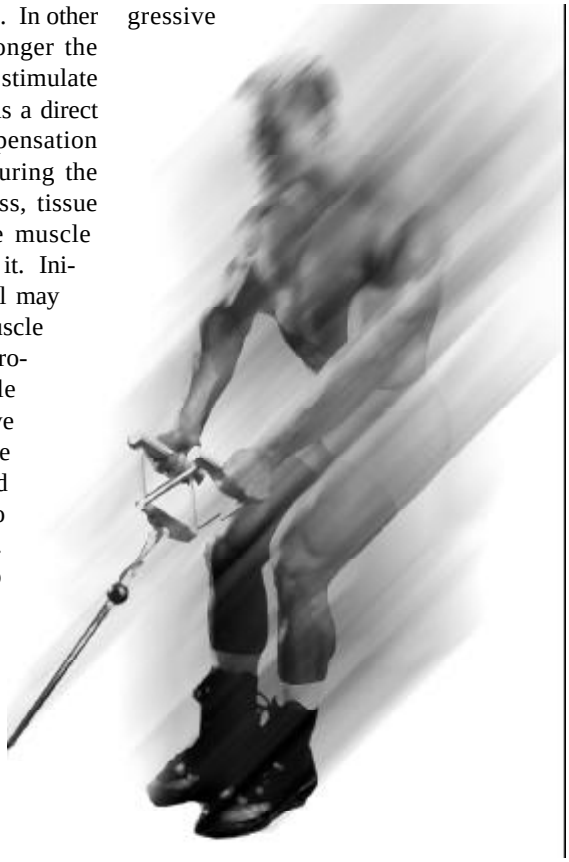
It is important to realize that during isometric and eccentric muscle actions we still have nerve impulses (action potentials) arriving at the muscle, triggering calcium release and activation of the actin-myosin cross-bridges, just like we do during concentric actions. The difference is that the force generated by the muscle is no longer sufficient to overcome the resistance. During isometric actions the sarcomeres remain the same length, and during eccentric actions the sarcomeres actually get longer. During eccentric actions the actin-myosin cross-bridges are still trying to pull the Z lines together to shorten the sarcomere, but they're just not strong enough. As you might imagine, this causes quite a bit of damage to the cross-bridges and to the whole sarcomere. The sarcomere is working to contract, but is being overcome by external forces which are forcing it to lengthen while it is trying to contract. This is the main source of microtrauma (microscopic damage) to the muscle that occurs when you work out. If you take a muscle biopsy (a small tissue sample) from a muscle after a workout and look at it in the electron microscope, you will see that the normal structure of the muscle has been disrupted. The amount of damage to the muscle is far greater following eccentric actions than for concentric or isometric actions, as you might guess. In concentric actions under heavy resistance, the microscopic structures of the muscle fiber literally get ripped apart as the muscle fiber is forced to lengthen while it is trying to contract.

Following intense training sessions we see a phenomenon called "Z band steaming," which describes the Z band structure being disrupted and myofilaments streaming out from the normal sarcomere structure. Under extreme conditions you can even see rupture (breakage) the

sarcoplasmic membrane (the cell membrane of muscle cells) and leakage of cellular contents from the cell. Some of these can be measured in routine lab tests in a hospital. Creatine phosphokinase (CPK) is an enzyme in muscle cells which forms creatine phosphate, the short-term energy reserve in muscle cells which is responsible for immediately replenishing ATP (refer back to our series on cellular energy metabolism). When muscle cells are damaged and the cell membrane starts leaking, CPK is released into the blood and can be measured in the laboratory. In hospitals CPK levels are used as an initial screen to tell if someone has had a heart attack or not, since during a heart attack some of the heart muscle cells die and release CPK. Skeletal muscle cells also release CPK when they are damaged. Using tests like muscle biopsy and CPK, scientists have determined that most muscle damage occurs during eccentric muscle actions, when external forces rip the myofibers apart. This is also the main cause of muscle soreness 24-48 hours after a workout, and is called "delayed onset muscle soreness," or DOMS. Try a few sets of heavy forced negatives sometime to prove it to yourself. It is well known to bodybuilders that negatives cause the most muscle soreness, and now you know why.

Why is all of this important to bodybuilders? Because it is at the very heart of muscle growth. You see, the microscopic tissue damage that occurs after weight training serves as the stimulus for inflammation. Inflammation is a process that occurs in damaged or infected tissues that signals the immune system to come into play. White blood cells, mainly lymphocytes, neutrophils, and macrophages, are called in to clean up the mess of the damaged and leaking muscle cells. The white blood cells release immune mediators such as histamine, bradykinin, cytokines, and interleukins, which help bring about the repair process. Bradykinin is one of the immune mediators that is particularly famous for causing pain, and immune mediators like bradykinin and prostaglandins are the reason muscles get sore after a workout. During the inflammation process, damaged cells and repaired and the tissue is returned to its original state. The body doesn't like this inflammation and repair process however, and overcompensates a bit during the repair process. The body makes the muscles a little bit bigger and stronger than they were before the workout, so that next time you hit the weights hopefully the muscles can take it and not get damaged. The body's ability to overcompensate is very limited however, and estimates are that with each good workout your muscles increase in size only about 0.1%. This is why it takes years of consistent training to get really big muscles.

There are two basic principles of bodybuilding training that are more important than all the others put together. The first is the principle of intensity. A workout must exceed some threshold of intensity in order to stimulate growth. The second is the principle of progressive resistance. This means that as you get stronger, you have to keep progressively increasing the resistance to overload the muscle. In other words, as the muscle gets stronger the intensity threshold required to stimulate further growth increases. This is a direct consequence of the over-compensation process I described above. During the inflammation and repair process, tissue remodeling occurs to help the muscle adapt to the stresses imposed on it. Initially, a 30 pound dumbbell curl may be intense enough to cause muscle damage and set into play the process of muscle growth. Muscle growth is really just an adaptive response that occurs so that the next time you curl a 30 pound dumbbell it doesn't cause so much damage to the muscle. After a while, you will be able to curl the 30 pound dumbbell easily, without much strain or damage to the muscle. At that point, the muscle and it's associated connective structures have adequately adapted to the stress imposed by a 30 pound dumbbell. You can keep working out with 30 pound dumbbells for the rest of your life and little, if any, additional growth will occur. The muscle has grown and adapted to that level of stress. If you stick to the 30 pound dumbbells you will find that over time you will be able to do more and more reps with 30 pounds, but that will do little to increase muscle size. Any time you're doing more than 12-15 reps with a weight you're primarily training muscle endurance, not muscle strength. Training for muscle endurance is just fine, but does very little to increase muscle size. To increase muscle size you have to increase strength, which means lifting a heavier weight. So you go up to the 35 pound dumbbells and get maybe 6 reps before your biceps fails. This represents a new level of stress, a higher level of intensity, and the adaptation process begins again. After a few weeks or months you will be able to curl the 35 pound dumbbells for 12 reps and your biceps will be bigger and stronger than it was when you could only curl 30 pounds for 12 reps. This is the principle of progressive



resistance.

For maximal gains in strength, you want to train with a heavy weight at low reps, say 3-6 reps. For maximal gains in muscle size, you want to train with a weight you can handle for 6-10 reps. As the muscle adapts and gets stronger, you will need to increase the weight in small increments (about 5-10% per jump) to keep yourself in the proper rep range. The most effective training strategies over the long haul involve some work in the 3-6 rep range and some work in the 6-10 rep range. This helps train the nervous system and well as the muscle and helps ensure the high threshold pathways are recruited. For purposes of increasing muscle size and strength, by the time you can perform 12 reps with a given weight this means it's time to increase the load.

Just how does this process of muscle growth and adaptation occur? There are two basic mechanisms that come into play: hypertrophy and hyperplasia. Muscle hypertrophy means that an individual muscle cell gets bigger. This occurs as it builds more myofibrils by adding more actin and myosin (and other associated structures). In other words, an individual muscle cell builds more contractile proteins inside it, making it increase in diameter. This of course also makes it stronger and able to generate more force when it contracts. Muscle hyperplasia describes the situation of adding more muscle cells. Hypertrophy is an increase in muscle cell size, and hyperplasia is an increase in muscle cell number. The overwhelming body of scientific evidence indicates that most muscle growth is the result of hypertrophy (2,3). If you take biopsy samples of muscle before and after a training program, you will see that after training there are still about the same number of muscle fibers (muscle cells), but that each muscle fiber is bigger in diameter. This indicates that hypertrophy is a more important adaptive response to exercise training that is hyperplasia. Several studies with bodybuilders do indicate however that muscle hyperplasia can occur. In these studies it was found that bodybuilders had more muscle fibers (cells) per cross-sectional area than untrained controls (2,3). One experiment with cats demonstrated a 9% increase in fiber number following 101 weeks of resistance leg training (2,3). To reconcile these observations with the body of data suggesting that most muscle growth occurs by fiber hypertrophy, it was suggested that in order for muscle cell hyperplasia to occur the training stimulus must be of high intensity, with heavy resistance and low repetitions (2,3). Most studies in exercise physiology use untrained subjects, with moderate to low resistance and higher repetitions. While both growth mechanisms are probably at play in bodybuilders, most experts agree that most muscle growth occurs by hypertrophy of existing muscle fibers.

When muscle cells do undergo hyperplasia, what is the source of the new muscle cells and the stimulus for their growth? This question is of course of great interest to bodybuilders, since it is the door to almost unlimited muscle growth. New muscle cells are believed to derive from differentiation and proliferation of satellite cells. Satellite cells are little tiny cells not much bigger than nuclei, and are found along the periphery of muscle fibers. Satellite cells seem to be most active during the growth of the fetus, while it is rapidly forming new muscle tissue. During adult life, satellite cells can be induced to turn into new muscle cells by factors released from damaged muscle cells (4). When satellite cells were placed in culture dishes it was found that they could be induced to differentiate (turn into new muscle cells) by adding an extract from minced or ground up muscle tissue (4). An extract from undamaged muscle or from some other tissue could not do the trick. Thus it appears that muscle cells contain some substance that can leak out when the cell membrane is damaged, and this substance acts as a signal to cause the satellite cells to grow. The idea is that satellite cells represent a reserve source of precursor cells that can be called upon following muscle damage, to make new muscle cells and repair the damaged muscle.

This all makes sense if you think about it. We know that most muscle cell hyperplasia comes about as a result of high resistance training with heavy weight (2). We also now that high resistance training, especially the eccentric phase of the muscle action, results in the most muscle damage (1,2,3). Finally, we also know that high resistance training is the most effective stimulus for increasing muscle size and strength (1,2,3). So it all fits together. And this is why it's vitally important for bodybuilders to pay special attention to the lowering phase of each rep - it's the most important part of the rep for stimulating muscle growth. You should always lower the weight slowly and resist the weight on the way down. This type of training will make you sore, but it's the best stimulus for muscle growth. I don't recommend negative-only training, however. You still need the positive (lifting) part of the rep to fully work the muscle and to exhaust its ATP stores. Since the muscle requires ATP to relax as well as to contract, if you use up the ATP in the positive phase of the movement, this will result in greater microtrauma during the eccentric phase. And this, presumably, will trigger a greater adaptive response and more muscle growth.

The Parrillo program is founded on the basics to help this process work at peak efficiency. I'm sorry, but there really are no tricks or secrets. It takes dedication, consistency, and hard work. What do you do? First, you have to make every workout count. Every workout must be intense enough to stimulate muscle growth, or you're just wasting your time in the gym. You have to attack each workout. Think of the weights as enemies to be conquered - to be slaughtered. Walk into the gym with a feeling of overwhelming power. The weights simply are not strong enough to resist you. You WILL lift heavy weights today. Get in there, kill the weights, and get out. That's your job.

Second, supply your body with more than adequate amounts of every nutrient it needs to build muscle. Protein, carbohydrate, vitamins, minerals, branched chain amino acids - and most importantly,

a foundation of solid nutritious food. Start with a solid bodybuilding diet and add supplements to boost cellular nutrient levels even higher. Don't compromise on nutrition. Can you imagine going to all that work of busting your butt in the gym and then not growing because of sub-optimal nutrition? The optimal bodybuilding diet is laid out in detail in the Parrillo Performance Nutrition Manual. Which foods to eat ,which foods to avoid, how much protein, carbs, and fat, how many calories, how many meals, and everything else you need to know. It even comes with a food scale and a food composition guide, so you can precisely structure each meal for optimal results. After the foundation is laid with the right foods, then add in supplements to boost nutrient levels even higher. Start with the basics: Hi-Protein Powder™, Pro-Carb™, Vitamins, and Minerals. Add in Muscle Amino™, for extra branched chain amino acids — the primary structural amino acids in muscle protein. If you're a hard gainer or want faster results, add in CapTri®. CapTri® supplies calories which are preferentially used for energy, sparing amino acids so they can be used to build protein instead of being burned as fuel. The special thing about CapTri® is that excess calories from CapTri® are readily burned as body heat instead of being converted to body fat. This makes CapTri® THE BEST way to add calories to your diet in a way that will minimize body fat. It's a hard gainer's dream come true.

Third, get adequate rest to allow muscles to recover between workouts. This is a must. Remember, muscles don't grow in the gym - they get damaged in the gym. The growth phase occurs during the next couple of days following a workout while the muscles are recovering. You have to get adequate rest for this recovery process to occur optimally. There's no simple answer to the questions of how often should you train each muscle, or how many days a week should you train. Trainers and muscle physiologists have been studying this for years, and still don't know the answer. The reason is that the optimal training protocol is different for different people. Hard gainers do better with less work and more time for recovery - say, training three days a week on a one on — one off schedule. People who are naturally muscular and gain muscle easily often can train more, three on and one off, for example. Some people even do well training every day, training one muscle group each day. Some professionals train twice a day. The optimal schedule for you depends or your own body's recovery ability as well as how many other stressors you have in your life. If you work 60 hours a week, for example, this takes a big toll on your recovery ability, and you probably won't be able to recover from daily workouts. Professional bodybuilders don't have any other job to worry about, so they are at an advantage in terms of recovery. You will have to experiment to find the best routine for your body. There are some basics however, that are true for everybody. You have to train hard. You have to give each workout everything you've got. You have to keep slowly increasing the resistance and getting stronger. The Parrillo Performance Training Manual describes all the best exercises for bodybuilders, with descriptions of proper exercise performance and sample routines. There's enough in there to take you from the beginning level all the way through the professional ranks.

Start off with the Nutrition and Training Manuals, which are where you get the information you need to reach your bodybuilding goals. At any time, feel free to call or write with questions or for personal counseling. We support our program all the way - we don't just sell you something and then turn you loose. What sets us apart is that Parrillo is a comprehensive package, a total program of training and nutrition, which is supported all the way. We supply information, not just supplements. We actually teach you what you need to know to become the best you can be. Who else does that? Who else sends out a free magazine to customers with scientific information about bodybuilding endocrinology, cellular energy metabolism, and muscle physiology just to educate customers so they can get the most out of the workouts? Nobody else. A lot of people sell supplements, but nobody else does what we do. We're for real. We're here for the few people out there who are really serious about reaching their goals. We believe that people who are dedicated and work hard in the gym deserve results. When you buy supplements from somebody else, that's all you get. But when you buy supplements or a manual from Parrillo, that's just the beginning of a relationship. That's our commitment to you. To supply not only the products, but more importantly the support and information you need to get results. That's why the serious people end up with Parrillo.

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Parrillo Performance Guide to Muscle, Part VI

by John Parrillo

Over the last five bulletins we've take a detailed look at muscle. We've covered basic scientific concepts of muscle structure, function, and physiology all the way down to the cellular and even molecular level. Now you know about the sliding filament theory of muscle action and the details of how muscle is controlled by the nervous system. In the last bulletin we talked the cellular and molecular basis of muscle growth, including muscle hypertrophy, hyperplasia, and the recruitment of satellite cells. In previous series we explored the aerobic and anaerobic energy metabolism of muscle as well as the hormonal regulation of muscle growth and the way to control hormones through diet and exercise.

This month I want to talk about different training strategies for muscle and how to tailor your training to achieve your particular goals. Bodybuilding, powerlifting, endurance running and biking, and sports like football and basketball all require muscle training, but obviously the performance goals of these sports are different and the best way to train for each of these is different. The place to start is to decide what your goals are, and then map out a plan for how to get there.

Let's start with powerlifting, since this is one of the simplest forms of training to consider. Powerlifting is about one thing: the guy who can lift the heaviest weight in proper form wins. The winner will thus be determined by two factors: his shear physical strength and his mastery of technique. At top level lifting events, technique gets to be very important. Elite lifters have great skill in using their strength to lift the heaviest weight possible. The technique of competitive Olympic-style lifting is a field in it's own right, and is not the topic here. What I want to discuss here is the strength aspect. Muscle strength is defined as the maximum load (weight) that a muscle can lift one time (1,2,3). Thus, the one rep maximum (1RM) is a measure of muscle strength. At first, you would think that the only important thing would be how strong the muscle is, and since bigger muscles are stronger, the guy with the biggest muscles would be the strongest.

The important thing is how much force the muscle can generate, which not only depends on how big and strong the muscle is but also on how efficiently the muscle can be activated by the nervous system. (Obviously, leverage factors like skeletal structure and tendon attachments also are very important, but there's not much you can do about that.)

This is not quite true, however. The important thing is how much force the muscle can generate, which not only depends on how big and strong the muscle is but also on how efficiently the muscle can be activated by the nervous system. (Obviously, leverage factors like skeletal structure and tendon attachments also are very important, but there's not much you can do about that.) You can easily prove this to yourself simply by comparing the physiques of bodybuilders and powerlifters. Bodybuilders have bigger muscles, but powerlifters are stronger. So muscle size must not be the only important thing. The higher the percentage of muscle fibers you can recruit to fire (contract) at the same time, the stronger a given-sized muscle will be. Estimates are that the average person has the ability to recruit only about 50% of the fibers of a muscle to fire at once, and that with training this may increase to around 70%. I'm convinced that elite powerlifters can probably do even better - maybe around 90%. It should be obvious that the more fibers you can get to fire at once, the more force the muscle will generate. This is why people see such great gains in strength during the first six months or so of training without seeing much increase in muscle size. What they're doing is learning how to more efficiently recruit the muscle fibers they have.

This is primarily a consequence of training the nervous system. With practice, your brain learns how to recruit more motor units to fire at the same time, resulting in greater force production from the muscle. This takes us back to one of the fundamental principles of training - that of training specificity. For powerlifting you want to increase strength, which means increasing your 1RM. To do this, you want to train at low reps with heavy weight. Since the competition involves lifting at low reps, you want to do most of your training at low reps. Scientific studies have consistently shown that the greatest gains in strength come from training in the 3-6 rep range with heavy weight (1,2,3). This rep range allows you to train with about 90% of your 1RM. You should also train some heavy singles, especially near the competition, but not at every workout since these are very hard on your joints. You should take plenty of time to rest between sets, generally from 3-5 minutes. This allows your nervous system and muscles to recover completely between sets so you can give maximal effort to each set. The best gains in strength usually come from relatively low volume training, around 3-5 sets per exercise. Keep the number of exercises and the total number of sets fairly low. The concept for strength training is to do a low

volume of extremely high intensity lifting. Train mostly the basic compound joint exercises, such as squat, deadlift, bench press, military press, and barbell row. These are probably the best exercises for increasing overall body strength.

Bodybuilding is a close cousin of powerlifting, and the training styles are very similar. The goal of bodybuilding is to maximize muscle size, more than strength, and to minimize body fat. Of course, muscle size and strength do go together, and big bodybuilders are indeed very strong. As we discussed last month, the main adaptation responsible for increases in muscle size is hypertrophy - an increase in diameter of muscle fibers (1,2,3). This is accomplished by addition of more myofibrils inside the muscle cell. Packing in more actin and myosin filaments will make the muscle bigger and stronger. The training strategy for this is similar as for powerlifting. For maximal increases in muscle size, it is best to train mostly in the 6-12 rep range with a moderate load (1,2,3). By "moderate" I mean the heaviest load you can lift for 6-12 reps in good form. This rep range allows you to use about 70-80% of your 1RM weight. It is important to train to failure at each working set, which means keep performing reps until you absolutely cannot get another. When you can perform 12 or more reps with a given weight, increase the weight by about 10%. This is the concept of progressive resistance.

Bodybuilders generally get better results from a slightly higher volume of training as compared to powerlifting, say 4-6 sets per exercise, and more exercises per muscle group. Powerlifters might do 8-12 total sets per workout while bodybuilders usually do 15-30. Rest intervals between sets are usually 1-2 minutes for bodybuilding. It is crucially important for optimal gains in muscle size for the bodybuilder to emphasize the eccentric phase of the muscle action. This means lower the weight slowly and resist the weight on the way down. This results in greater micro-trauma to the muscle fibers, and this damage serves as a stimulus to the adaptation process resulting in increases in muscle size. Refer to the Parrillo Performance Training Manual and High Performance Bodybuilding for detailed information on the best exercises for bodybuilders and for instruction on proper exercise performance.

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The best bodybuilders also incorporate powerlifting-style training into their workouts. Many bodybuilders actually start off as powerlifters for a few years to get a solid foundation of strength, and then use bodybuilding-style workouts to refine their size and shape. There are several ways to incorporate both training styles into your workouts. One way is to do some very heavy sets to failure at 3-5 reps, followed by some moderate sets to failure at 6-10 reps in a single workout. This approach trains for muscle size and strength at each workout. Another increasingly popular approach is called "periodization," Which involves a cycle of relatively light break-in training, followed by a cycle of bodybuilding style training, followed by a cycle of powerlifting style training. Each cycle can last from about 4-12 weeks, depending on what works best for you. When you hit a plateau in your training, it generally means it's time to move to a new workout.

Sports like sprinting, football, and basketball require maximal muscle power, which is different from strength. Power is work per unit time, which is also equal to force times speed. Power requires generating a lot of force, and generating it quickly. Force is equal to mass times acceleration, so the faster you accelerate a given weight, the more force you're producing. In sports like football and boxing, the transfer of kinetic energy from one player to another is very important. Kinetic energy is equal to one half the product of mass times velocity squared, so the faster you're moving the more kinetic energy you have. To sum up, powerlifting and bodybuilding are just concerned with muscle size and strength, but these other sports add in the factor of speed.

As an example, if two athletes have a 1RM of 200 pounds on the bench press they have the same strength on that exercise. But if one athlete can perform the movement in 2 seconds while the other requires 4 seconds to lift the weight, the former is generating twice the power of the later. While absolute strength is an important component of performance, power is probably even more important for most sports (1). Muscle power is the product of strength and speed, both of which are obviously central to football, basketball, and like sports.

Training the speed component adds another factor to your training. As you might guess, this involves trying to lift the weight as quickly as possible. One effective approach to weight training for speed calls for using about 30% of your 1RM weight and performing the positive (lifting) phase of the movement in explosive fashion. This is usually done for about 10 reps per set. Another technique to increase muscle power is plyometrics. Plyometrics is a way of overloading the muscle prior to an explosive contraction with speed-strength as the goal (3). An example of plyometric training for legs is to step or jump off of a box, land and squat, and then jump up as fast as possible. This does two things. First, potential energy is stored by stretching the connective tissues, such as the muscle sheath, the tendons, and the muscle itself. Second, the rapid eccentric movement of landing and squatting evokes the stretch reflex, or the stretch-shortening cycle (SSC) of the same muscle (3,4).

The basis of the stretch reflex is the muscle spindle. Muscle spindles are sen-

sory nerves located in special muscle fibers called intrafusal fibers. These fibers run parallel to the extrafusal muscle fibers, which are the ones we normally think of as being responsible for muscle contraction. When a muscle is stretched this activates the nerves in the intrafusal fibers, which sends a signal back to the motor neurons in the spinal cord. These send a signal out to the extrafusal fibers to contract. The muscle spindle is a safety mechanism that causes a muscle to contract whenever it is stretched. This reflex keeps the muscle from tearing from excessive stretching. When you add in this reflex arc, this results in a more powerful contraction from a stretched muscle than can be consciously achieved by contracting a muscle from it's normal resting length. The elastic properties of the muscle and tendons store energy during the eccentric (stretching) phase, and this also contributes to force production (3). Another form of plyometric leg training is jump squats, where a relatively light weight is used and you jump when coming out of the squat, with your feet actually leaving the ground. Baechle (reference 3) contains an extensive list of plyometric training drills and techniques for those of you interested in more information.

The best form of training for competitive endurance activities is training that activity itself. In other words, endurance cycling is the best way to train for endurance cycling. That's not to say that weight training can't help, but weight training is mainly about muscle size, strength, and power, not endurance. Endurance training is an aerobic exercise activity, while resistance training (weight training) is anaerobic. Endurance training involves a very large number of submaximal muscular contractions (3). Compared to weight training, the intensity is very low and the volume is very high (3). The adaptations to aerobic training are very different than those to anaerobic training. Endurance training reduces the overall concentration of glycolytic enzymes, the ones involved in anaerobic energy production (3). In endurance training there is increased recruitment of type I muscle fibers compared to type II fibers (3). However, since type I fibers have less capacity for hypertrophy than do type II fibers, endurance training does not result in as great an increase in muscle size as does resistance training.

During endurance training there is a gradual conversion of type IIb fibers to type IIa fibers (3). Type IIa fibers, or fast oxidative glycolytic (FOG) fibers, have a greater aerobic capacity than type IIb fibers, or fast glycolytic (FG) fibers (3). The result of this conversion is a greater number of fibers which can contribute to endurance performance (3). Endurance training increases the number of mitochondria and the concentration of myoglobin in muscle cells (3). As you know, mitochondria are the organelles responsible for aerobic energy production. Myoglobin is a protein which can bind and store oxygen, much like hemoglobin. Thus while weight training mainly results in bigger, stronger muscles, endurance training results mainly in increased aerobic energy producing ability.

Bodybuilders should remember however to include aerobic exercise as part of their training, since this trains a very important muscle called the heart. Aerobic exercise also burns fat and helps to increase capillary density in muscle. This allows for increased blood supply, which means increased nutrient supply, which means bigger muscles.

This concludes our series on muscle. Whatever your training goals, don't forget the central role of nutrition. Serious training is hard work - don't throw it away by not eating right. Try to eat every three hours or so, and include the right balance of carbohydrates and protein at each meal. Good protein sources are chicken breast, turkey breast, fish, and egg whites. Good carbs include potatoes, rice, beans, oatmeal, peas, corn, and vegetables. Refer to the Nutrition Manual for detailed instruction. As far as supplementation goes, the most important ones for increasing muscle size and strength are Hi-Protein Powder, CapTri, and Muscle Amino. For endurance performance, the most important are Pro-Carb, The Bar, CapTri, and Max Endurance. Never lose sight of your dream. Never give up. The Parrillo Program has built a lot of champions, and we'll build a lot more. Be one. Parrillo Performance - where dreams come true.

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Muscle Up - The Keys to Building Mass and Staying Lean, Part I

by John Parrillo

Sometimes as you read this column, you may get the impression that attaining a bodybuilding physique is pretty easy. I talk about how to control your hormones, how to stimulate fat loss, how to drive muscle growth, how to channel food energy to muscle stores, and so on, and bodybuilding sounds not too hard. The truth is, achieving a bodybuilder's physique is very hard, and that's why you don't see too many bodybuilders walking around. If it was easy, everybody would look great.

The key reason why it's so hard is that you have to be in a calorie deficit to stimulate fat loss, yet in order to drive muscle growth you have to supply all the nutrients and energy muscles need to grow. In a way it's a paradox to do both at the same time. But it is possible.

The easiest way to lose fat is just to starve yourself. Starving people are not fat. As you know, the problem with this approach is that during severe caloric restriction you lose about half muscle and half fat. Your body tries to hang on to the fat as long as it can so it won't run out of energy. At the other end of the spectrum, is pretty easy to gain weight if you just eat like a pig. There are very few people who can't gain a lot of weight if they just eat enough calories. This is what the hoard of "weight gainer" powders out there are for. If you add 1,000 calories a day to your diet, you will gain weight. The problem, of coarse, is that if you just indiscriminately add calories to your diet most of them (probably about 75% by most estimates) will end up as fat.

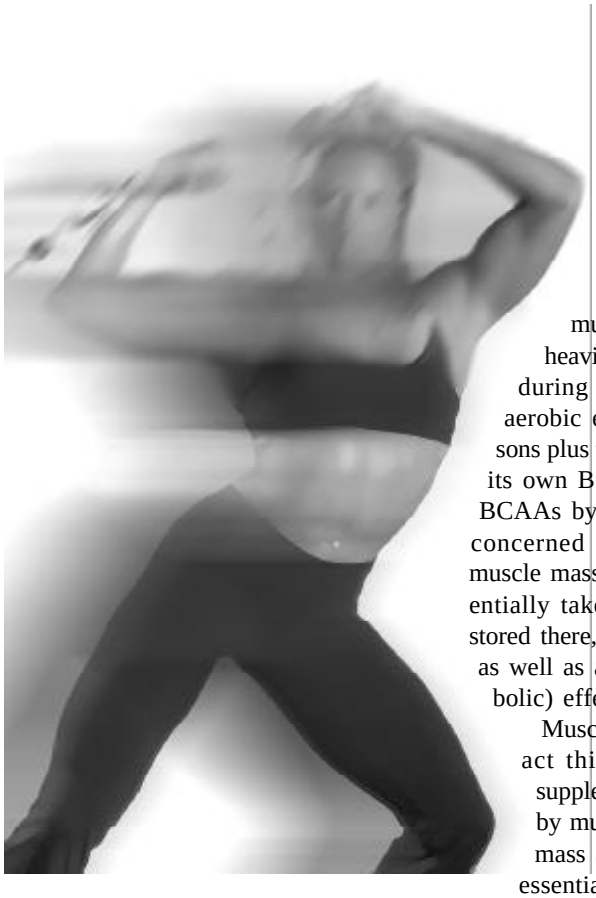
So we have to lose calories to lose fat, but if we cut calories half the weight which is lost will be muscle. And we have to add calories to gain weight, but about 75% of excess calories usually end up as fat. Genetically gifted bodybuilders may not have such a problem. I've met several people who were quite strong and who looked like bodybuilders before they ever went into a gym. But these people are rare. Most of us are all too familiar with the scenarios described above. And this is why attaining that bodybuilding look is hard for most people.

The key concept is an idea called nutrient partitioning, which means directing ingested dietary energy toward the lean compartment and not to fat stores. The idea is to have your food energy go to build muscle while drawing on your fat stores to fuel activity.

What's the answer? How can the average person attain a really spectacular physique? Hard work, consistency, and dedication. These are the core principles of the Parrillo philosophy. If you can give me those, I can give you a great physique. Without those, all the information and training and supplements in the world just don't matter. It's really up to you. So how do you do it?

The key concept is an idea called nutrient partitioning, which means directing ingested dietary energy toward the lean compartment and not to fat stores. The idea is to have your food energy go to build muscle while drawing on your fat stores to fuel activity. Achieving this requires two things. First is a very specific eating program which supplies energy is a way which supplies nutrients to build muscle but not providing calories which are stored as fat. There are certain foods you should eat and specific foods you should avoid. Each meal must be structured according to fairly narrow parameters. The nuts and bolts of how to do this is described in the Parrillo Performance Nutrition Manual, which is the cornerstone of the program. The second requirement for nutrient partitioning is a training program. Training provides the stimulus to build muscle as well as activating the body's fat-burning pathways. How does it work? What happens is the nutrition program and the training program come together to have certain effects on the body's hormones. And these hormones control muscle metabolism and fat metabolism. If you follow the program faithfully you can actually modify the hormonal environment inside your body in such a way as to signal your muscles to grow and simultaneously signal fat loss. And by supplying nutrient energy is a specific pattern you can direct this energy to the lean compartment while at the same time burning body fat. If you read my articles over the last two or three years you will have a virtual textbook on the science of how this works, down to the cellular and even molecular level.

So let's say you want to do it. Where do you start? You start with the Nutrition Manual and a solid training program which includes lifting weights and aerobics. It's virtually impossible to achieve the results of my program without the Nutrition Manual. Virtually every advanced level bodybuilder in the world is on this program, and that's no exaggeration. You have to start there. I've spent over twenty years researching this area and experimenting with advanced level competitive bodybuilders. My approach has been to assemble all of the scientific information on muscle and fat metabolism, and then



try different strategies in real athletes to find out what really works. The Nutrition and Training Manuals give you the benefit of twenty years of research and work right at your fingertips.

Are there any supplements that can help? Yes, definitely. One in particular that fits into this program is called Muscle Amino™. Muscle Amino™ is a pharmaceutical grade, ultra-pure, crystalline, free-form amino acid mixture of leucine, isoleucine, and valine. These are the so-called "branched chain" amino acids, because their side chain contains a branched carbon structure. The branched chain amino acids (BCAAs) are among the essential amino acids. Of the twenty amino acids common in human proteins, twelve of them can be made by the body and are called "nonessential" amino acids. The other eight cannot be made by the body and are called "essential" amino acids because it is essential they be obtained from the diet. Obviously, bodybuilders need to be attentive that their diet supplies all of the essential amino acids they need, because they are required for muscle maintenance and growth.

There are two special things about the BCAAs: they are among the most abundant amino acids in muscle proteins (1) and they are heavily catabolized (broken down) during exercise, especially intense aerobic exercise (2). These two reasons plus the fact the body cannot make its own BCAAs increase the need for BCAAs by athletes, especially athletes concerned about achieving maximum muscle mass. BCAAs seem to be preferentially taken up by muscle tissue and stored there, providing an anabolic effect as well as a nitrogen-sparing (anti-catabolic) effect (3).

Muscle Amino™ is really the exact thing we're looking for in a supplement. It's selectively taken up by muscle, so it will add to muscle mass and not fat mass. It provides essential building blocks which are used to build muscle protein, having a anabolic effect. And it blocks break-down of existing muscle tissue during intense exercise. This is a perfect example of positive nutrient partitioning. Muscle Amino provides nutrient energy which is specifically targeted to building up muscle stores while not contributing to fat stores. You can see why I call it "Muscle Amino."

Exercise induces changes in the body's pattern of energy metabolism, and these changes are driven by energy needs, substrate availability, and hormonal regulation (2). This change in the pattern of energy flow in the body is what brings about the change in body composition we seek. Energy to fuel to body is derived from oxidation (burning) of the carbon chains in carbohydrates, fats, and proteins. The ratio of the fuel mixture which is oxidized depends on the nutrient ratio consumed as well as exercise type and intensity (2). In other words, whether you burn fat or carbs or protein for energy depends on what you eat and how you exercise.

During normal conditions, 80 - 100% of the body's energy requirements are supplied by fats and carbohydrates (2). This means that amino acids can provide up to 20% of energy needs on a daily basis, and more during intense exercise. In one study protein breakdown and use of amino acids for fuel were measured in men following a 10 mile run. It was found that 57 grams of protein were consumed as fuel during the run, accounting for 18% of the energy cost of the run (2). This means that as much as the entire USRDA for protein can be burned during a single intense aerobic exercise bout. There seems to be little doubt that intensely training athletes need more protein than sedentary people, since the energy cost of exercise results in a significant amount of amino acid oxidation.

Bodybuilders virtually unanimously agree that they need extra protein. Most of them have the misconception that they need extra protein to supply the building blocks for muscle growth. The truth is that two or three extra bites of chicken every day will supply enough protein for your muscles to grow as fast as they can. The real reason bodybuilders and endurance athletes need more protein is that they burn more protein for fuel during exercise. If you don't supply enough protein in the diet to make up for this increased demand then the body will actually break down muscle tissue to supply the amino acids to use as fuel. This is your worst nightmare. Since the biggest demand for amino acid fuel is during aerobic exercise, it turns out that endurance athletes actually have even higher protein requirements than bodybuilders (2). Very few people realize this, including very few endurance athletes. This is why endurance athletes usually have a very thin (sometimes referred to as "stringy") look - they burn more protein than they take in, so their muscles get catabolized as fuel. If endurance athletes would simply increase their protein intake they would become more muscular and stronger, and probably become better, faster athletes as well. Usually in a contest between two equally

skilled athletes, the stronger one wins.

Muscle mass is determined by the balance of protein synthesis and protein degradation (2). When synthesis exceeds degradation, protein mass accumulates and the body is said to be in positive protein balance (or positive nitrogen balance). When degradation exceeds synthesis, the body is in a negative protein balance and muscle mass is lost. The proteins in your muscles are not exceptionally stable over time, but rather are in a constant state of "turnover." This means that every day some of your body proteins are broken down and destroyed to be replaced with new proteins. Proteins are the mechanical workhorse of the cell, being responsible for doing the physical work of life. For example, during muscle contraction what happens is protein filaments called actin and myosin slide past each other in opposite directions, thus making the muscle shorter. Like any mechanical parts that move and rub against each other, they get worn out. After a while the old proteins are broken down and replaced with new ones.

When you eat a protein food, it gets digested in the stomach and intestine into individual amino acids and short chains of amino acids that are small enough to be absorbed into the bloodstream. Eventually all of the protein is broken down into individual "free" amino acids. These can experience two main metabolic fates. They can be used to build new proteins or they can be burned as fuel to produce energy. Not all of the amino acids are treated equally however. The branched chains are used as fuel more than the others (2). Muscle contains special enzymes called branched chain aminotransferase and branched chain keto acid dehydrogenase which permit the breakdown of the BCAAs for energy (2). This allows muscle to use BCAAs as fuel whereas the other amino acids are oxidized in the liver. So while exercise increases protein requirements in general, it especially increases BCAA requirements.

This coupled with the fact that the BCAAs are among the most abundant amino acids in muscle protein make it obvious why athletes have increased need for the branched chains. They use more for energy, plus they need more for protein synthesis. Virtually every book and article about supplementation for athletes suggest the BCAAs as one of the core supplements. Of all the supplements out there, Muscle Amino is certainly one of the most high-tech, because it specifically targets the metabolic problem at hand. By supplying more BCAAs to the body less muscle tissue is catabolized during exercise, helping to maintain positive protein balance and net gain of muscle tissue. This is a prime example of a low calorie nutrient which specifically targets metabolic pathways to have a positive partitioning effect. Muscle Amino™ is selectively taken up by muscle where it acts to promote protein synthesis and prevent protein breakdown. Since it is taken up by muscle and not by fat, this is a way to supply nutrient energy which will be partitioned to the lean compartment. It should be emphasized that endurance athletes will benefit from this supplement at least as much as bodybuilders, if not even more.

To see a real noticeable effect from Muscle Amino™ you need to take a fair amount of it. At least ten grams a day, and twenty would not be too much. I suggest three capsules with each of six meals per day. Smaller amounts will have a smaller effect, but this is a supplement where the effects accumulate over time. It is best to take Muscle Amino™ with meals to increase absorption. There's a lot more to be said about amino acid metabolism during exercise, and how to use exercise and nutrition to shift your metabolism into a muscle-building, fat-burning mode. I'll pick up here next month and get into some of the molecular details of what's happening with amino acid metabolism during exercise and how to use this information to maximize muscle mass.

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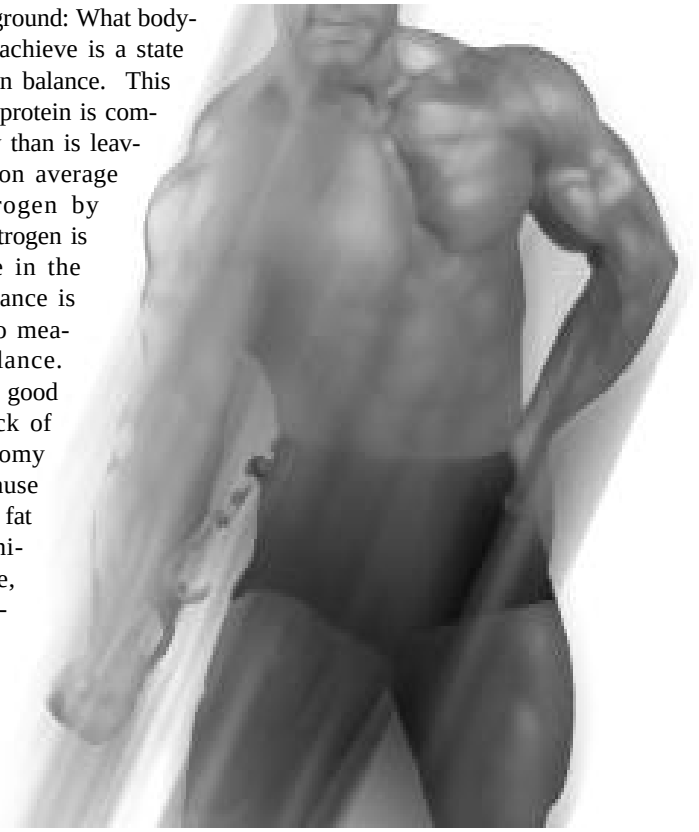
Muscle Up - The Keys to Building Mass and Staying Lean, Part II

by John Parrillo

For years bodybuilders have asserted that they need more protein than average people, and all the while nutritionists have kindly replied, "No, you don't." Most of the scientific studies show that athletic activity does not appreciably increase protein requirements. Could it be that bodybuilders really don't need any "extra" protein? Think about this for a minute: Muscle is about 75% water, so a pound of muscle only contains about 100 grams of protein. Most people would consider gaining 10 pounds of muscle a year to be good progress, and that would amount to 1,000 grams of protein. Over a year's time, that equals out to gaining 2.74 grams of protein per day, which is about one or two bites of a chicken breast. So, they say, eat a couple extra bites of chicken breast and that's enough protein to grow as big as Arnold.

Bodybuilders, on the other hand, have said that if they want muscles twice as big as everybody else they have to eat twice as much protein as everybody else. They need extra protein to supply the building blocks to build extra muscle. So who's right?

Well, neither party turned out to be exactly right. Bodybuilders do need more protein than average people, but not for the reason they thought. In fact, those two extra bites of chicken every day would be enough to grow muscles as big as Arnold's, if it all ended up being converted to muscle. The problem is, it doesn't. The original studies looking at protein requirements of athletes were flawed in several ways. First, they used untrained athletes and the exercise protocols were not very intense. The subjects simply did not exercise long enough or hard enough to see an effect of exercise on protein requirements. Second, in the old studies nitrogen lost in sweat was not measured, and this turns out to be significant.



A little background: What bodybuilders seek to achieve is a state of positive protein balance. This means that more protein is coming into the body than is leaving. Protein is on average about 16% nitrogen by weight. Since nitrogen is easy to measure in the lab, nitrogen balance is used as a way to measure protein balance. Nitrogen is also a good way to keep track of the protein economy in the body because carbohydrate and fat do not contain nitrogen. You see, when we eat excess protein it can be stored as muscle, but it could also be converted to fat. If it is converted to fat, the nitrogen is removed (as ammonia) and is excreted in the urine (after the ammonia is converted to urea). This leaves the carbon skeleton of the amino acids, which can be broken down and used to make fat. By measuring nitrogen balance we see how much nitrogen is entering the body and how much is leaving, and any that remains in the body must represent new protein tissue.

The old studies measuring nitrogen balance in athletes looked at how much nitrogen was consumed as protein in the diet versus how much nitrogen was excreted in urine and feces. They found that athletes could remain in nitrogen balance without eating much, if any, extra protein. This is the basis for the long-standing disagreement between bodybuilders and nutritionists. During the last few years a number of important studies have been performed showing that hard-training athletes may actually need vastly more protein than average people. The new experiments also measure nitrogen lost in sweat, which the older studies failed to do. Also, the new experiments are much more realistic, using experienced athletes in intense training programs. It turns out that a significant amount of nitrogen can be lost in sweat, and if this is factored in then intensely training athletes may need as much as two or three times as much protein as an average person to maintain nitrogen balance (1-18). (I have included a rather extensive reference list here, as this controversial topic has been the subject of much research. If you're only going to read one reference, read #17 by Peter Lemon. It's an excellent review that

puts a lot of this in perspective.)

So what does all of this mean? Do athletes need more protein? Yes, definitely, they need significantly more protein than sedentary people. The controversy is over on this argument, and now even the old-school nutritionists agree. Do bodybuilders need more protein so they can have more substrate to build new muscle tissue? No, they need more protein because they excrete more nitrogen during exercise. In other words, very little extra protein is needed to build new muscle tissue, but a lot of extra protein is needed to make up for how much is burned as fuel during exercise.

The branched chain amino acids (BCAAs) are of special importance to athletes because they are metabolized in muscle, rather than in the liver. Here's what happens: After you eat the food is digested and absorbed into the bloodstream through the small intestine. The blood from the small intestine drains into a special vein called the portal vein, which goes to the liver. So the liver gets first "dibs" on all the nutrients before they are transported to the rest of the body. (With the exception of long chain fats, which enter the lymphatics and bypass the liver.) The primary site for degradation of most amino acids also happens to be the liver (19). The liver thus has the ability to break down most amino acids for energy when it needs to, such as during starvation or during intense exercise. The first step is to remove the amino group (-NH2) from the amino acid. This is accomplished by enzymes called transaminases or aminotransferases.

However, the liver is very low in branched chain aminotransferase, which means it can't break down BCAAs to a significant extent. This results in release of any BCAAs from the liver into the circulation (19).

Skeletal muscle does contain branched chain aminotransferase and thus is able to break down the BCAAs for energy. During periods of increased energy need such as starvation, trauma, or exercise, the enzyme pathways responsible for

BCAA oxidation are activated. Notably, however, during resting periods in the absorptive state (after a meal) when other fuel sources are available such as glucose or ketones from CapTri®, these alternate fuel sources "spare" the BCAAs from catabolism (degradation) leaving them available for use in protein synthesis. Thus after a meal there is a small burst in liver and muscle protein synthesis, after which time any left over amino acids are burned for energy or converted to glucose and stored as glycogen (20).

It is estimated that about one third of the amino acids entering the liver from the portal vein are used for protein synthesis by the liver (serum proteins) or are converted to glucose or used for energy by the liver (20). Thus a high protein meal only increases serum amino acid levels by about 20%.

Well, so what, and what does all this have to do with bodybuilding? Remember that the liver does not have the enzymes to metabolize the BCAAs, and this means that the BCAAs increase markedly in the bloodstream after a meal. (In other words, they pass straight through the liver without being broken down.) In fact, the BCAAs can account for about 70% of the amino acids released from the small intestine via the liver to the rest of the body (20). Are you starting to get the idea that the branched chain aminos are important in muscle protein metabolism? Indeed, it has been shown that the BCAAs account for 50-90% of the amino acids taken up by muscle tissue in the 3 hours following a protein meal (20). The branched chain aminos are also effective at stimulating insulin secretion, which in turn stimulates protein synthesis.

So what's the bottom line here? First off, the branched chains account for 50-90% of the amino acids taken up by muscle after a protein meal. Once there, they are available to serve as substrate for protein synthesis. They increase insulin, which further stimulates protein synthesis. This is their anabolic effect. During periods of intense exercise, they can be burned for energy, helping prevent breakdown of muscle tissue to use as fuel. This is their anti-catabolic effect. Parrillo Performance Muscle Amino™ is a special formulation of BCAAs in the proper balance to help promote muscle growth and prevent muscle breakdown. The best way to use it is to take it with meals, and to eat six small meals per day. The most important times to take it are the meal before your workout and the meal after your workout. I suggest taking three to six Muscle Amino™ caps with a Pro-Carb™ drink after your workout. The carbohydrates will prevent oxidation of the BCAAs, leaving them available for use in protein synthesis. The insulin release from the Pro-Carb™ will help drive the aminos

inside the muscle cells, as well as stimulating protein synthesis (20). This is also the optimum time to replenish glycogen stores. Another suggestion which seems to be very effective is to use about one tablespoon of CapTri® with each meal. The ketones spare oxidation of the BCAAs, leaving them available for use as protein. This enhances their anabolic activity. Combine this supplement program with a healthy diet adequate in calories and protein, and I think you've got the best muscle-building program modern science has to offer.

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MCT's — Setting the Record Straight

by John Parrillo

There has been some confusion in the recent bodybuilding literature about metabolism of medium chain fatty acids, or more precisely, medium chain triglycerides. The specific areas of uncertainty revolve around whether MCTs are converted into ketones and if they are stored as body fat.

Since what has been written contains come misinfomation, let's start with the general and move to the specific. First, when people disagree about technical matters like this it's always nice to check their references. If somebody takes a position and defends it by citing references to the scientific literature, he might be right or he might be wrong, but at least you have the option of checking the information out for yourself to see if he has interpreted it correctly. When people comment on research results and don't cite any references, then they're asking you to take their word for it without furnishing any proof one way or the other. I try to stay out of discussions like this because without any objective data it just turns into an argument about opinions. Don't get me wrong: expert opinions are important and count for a lot, but you can't really have much of a discussion of scientific research without citing the literature.

The next general issue has to do with if MCTs are stored as body fat. This seemingly simple question has a relatively complex answer. Literally speaking, the human animal stores fat in the form of long chain triglycerides, LCTs. These are triglycerides comprised of fatty acids 14 carbons long or longer. Most fatty acids in human fat are either 16 or 18 carbons long, with a small percentage being longer. So, literally speaking, MCTs are not stored as fat in the human (or in rats, where a lot of research was also done). Does this mean we can eat all the MCTs we want and never get fat? Of course not. If you eat too many calories you will gain weight, and for most people, most of the time, any extra weight they gain from over-eating will be fat mass. I've said this before many times, but I'll say it again to make sure I'm understood: too many calories from any source can be converted to fat. What you have to realize is that different foods are metabolized differently in the body, and don't all have the same tendency to store as fat. So all foods have the potential to be converted into body fat if consumed in excess, and what bodybuilders want to do is pick the food choices that have the least tendency to do so, while having the greatest tendency to contribute to muscle tissue.

So what is this business about different foods having different tendencies to be converted to fat? This is one of the most exciting and important discoveries in nutrition since vitamins. It comes from the realization that while protein, carbohydrate, and fat can all be converted into usable energy in the form of ATP, they follow different metabolic pathways and are thus converted into energy with different efficiencies. Chapter 8 in reference 1 contains detailed calculations showing that different dietary energy substrates are converted into ATP with different yields.

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The experiments done specifically with MCTs sought to determine if including MCTs in the diet can reduce fat accumulation during over-feeding, compared to other foods. References 2-6 describe what are the best studies done to date on this issue. These studies are well-controlled trails in rats and humans that measure the effect of replacing some part of dietary energy as MCT. It was found that if conventional fats (LCTs) are replaced by MCTs this results in diminution of fat stores. This is explained by the fact that MCTs are profoundly thermogenic, so a significant fraction of the dietary energy supplied by MCT is released as body heat, making it not available for storage as fat. References 2, 4, and 6 specially demonstrate the thermogenic effects of MCTs, including studies in humans. Reference 7 is an excellent review article on the subject.

Let me clear up one minor area of confusion on thermogenesis, while I'm on the subject. Thermogenesis, or more properly the thermic effect of feeding, refers to increases in body heat production following feeding. All foods release heat when they are burned. Indeed, maintenance of core temperature is one of the main functions of dietary energy. Different foods release different amounts of heat when they are burned. MCTs happen to be profoundly thermogenic, meaning that they release a lot of heat (2,4,6,7). This is a consequence of the metabolic pathway they follow, which is in turn a consequence of their unique molecular structure (7). It has nothing to do with increasing thyroid hormone or noradrenaline levels and re-setting the thermostat in the hypothalamus, but is merely a result of rapid metabolism and conversion of dietary energy to heat within the liver. This does not mean however that they increase

body temperature. It has been well known for years that MCTs are thermogenic without increasing body temperature (7). This just means that as more heat is produced, it is liberated to the environment. If foods, including MCTs, elevated body temperature then we would get a fever after we ate, and if we ate too much we would die from hyperthermia. It doesn't work that way.

Regarding the question of ketogenesis, I'm glad that was brought up because that's one of the key things that makes MCTs so special. It is quite correct that regular fats, including conventional dietary fats as well as body fat, are not converted into ketones to any appreciable extent as long as carbohydrate fuel is available. This is because regular fats require the carnitine shuttle to transport them across the mitochondria membrane to the mitochondrial matrix, where they are metabolized to produce ATP or else converted into ketones. The carnitine shuttle requires the activity of an enzyme called carnitine acyl-transferase I, or CAT-I, which sticks a fatty acid onto carnitine, which then carries it across the mitochondrial membrane. CAT-I is inhibited by malonyl-CoA, a byproduct of carbohydrate metabolism. This means that fat metabolism is effectively shut down (or at least significantly down regulated) as long as carbohydrate fuel is available, and this is the molecular switch that does it. The special thing about MCTs is that they can enter the mitochondria by passive diffusion, without the help of the carnitine shuttle (7). This means they are rapidly oxidized as fuel even in the presence of glucose (7). The MCT is burned so rapidly, in fact, that the capacity of the Krebs cycle to produce ATP (literally reducing equivalents, which are later converted to ATP) is overwhelmed (7). This means that MCT is burned faster than the mitochondria can produce ATP, so the rest of the energy is converted into ketones. The ketones then leave the liver cell and are carried by the blood to muscle, where they are used for energy (7). One of the most amazing things about MCT is that it is converted into ketones even in the presence of glucose (7). This is a well established fact that has been in the literature for years. Many studies (reviewed in reference 7) have shown a sharp increase in ketone production following MCT ingestion, even in the presence of glucose levels which inhibit ketone production from regular fats.

These ketones are taken up mostly by muscle (the brain continues to run on glucose as long as it's available) and rapidly burned for energy. In fact, they are converted into ATP preferentially over glucose, having what is called a "glucose-sparing" effect (7). The ketones are burned first, saving the glucose for later. If you don't see ketones in your urine with

Ketosticks while you're using MCT, this means it is working like it is supposed to, and the ketones are being used as fuel inside muscle cells. If you use more and more MCT, eventually you will indeed see ketones spilling over into your urine. At that point it means you're using too much and your supplement dollars are just ending up in the toilet.

Now I want to get back to a question I touched on earlier, and that is the issue of storage of MCTs as body fat. As I explained, MCT is not directly stored as fat, but it is a concentrated source of calories. Too many calories in any form can contribute to fat stores. How this happens with MCTs is that they are broken down into acetyl-CoA, which are two carbon fragments of fatty acids (acetate) attached to co-enzyme A (Co-A). These acetyl-CoA units then can be re-assembled into long chain fats, most commonly 16 carbons long, and subsequently stored as body fat (8). So while MCT is not stored directly as fat, it can be converted into LCT which is stored as fat, just like any other food. The point, which has been proven over and over in the literature (2-8), is that calories derived from MCT have much less tendency to be converted into body fat than excess calories from other food sources. This is because excess calories from MCT are preferentially lost as heat through the process of thermogenesis, making them not available for storage (2,4,6,7). This makes MCT the ultimate energy source for bodybuilders, since it is a form of calories with less tendency to store as fat than conventional fats or even carbohydrates.

Finally, it deserves mention that none of the scientific studies in the medical literature were done with bodybuilders. That's where our research here at Parrillo Performance picks up. We learn as much as we can from the literature, and then work on how to best use that information to make better bodybuilders. We've personally done the research over the years to determine the best way to incorporate MCTs into a diet to derive maximum benefit from this unique energy source. If you're still confused and don't know what to believe, you have two options left. One is check out the scientific literature for yourself. By siting specific references, I've given you that option. Second, try MCT for yourself and see if it works. Be sure to use it as instructed in the Parrillo Performance Nutrition Manual. The basic concept is to substitute MCT-derived calories for an equivalent amount of calories from convention fat or carbohydrates. This increases the thermogenic effect of the meal, thus decreasing fat storage. Some people make the mistake of simply adding several hundred calories a day of CapTri® to

their normal diet without making any other changes. This, of course, just adds calories to the diet and may increase fat accumulation and as mentioned earlier, excess calories from your diet can be converted to body fat. CapTri® is not some magic fat-burning chemical. CapTri® is not a drug. It's just a very special nutrient that supplies energy in a way less likely to be stored as fat that regular foods.

As with any supplement, the key is to use it in the proper way in combination with the proper diet. There's no substitute for a sound nutrition program, but by using supplements to complement your nutrition program, you can take your training and physique even further. CapTri® is an extension of the Nutrition Program. You use it for added calories in your diet. But you can't just start taking it, without first establishing a good nutrition program.

So why use it? Here's some of the ways bodybuilders and other athletes utilize this supplement in a positive way. First, CapTri® can help you gain muscle, by providing extra energy for increased intensity in workouts and by sparing amino acids that could be oxidized during this training. Second, CapTri® is used by bodybuilders as a replacement for carbohydrates when dieting. The key here is to change the insulin:glucagon ratio so more fat is burned. By replacing carbs with CapTri®, you increase your protein:carbs ratio, thus decreasing the amount of insulin in the blood. That sparks the release of glucagon which promotes fat metabolism for energy in the body. And while a low-carb diet alone would tired and lifeless, the calories from CapTri® provide the energy to continue training hard and burning fat. Third, bodybuilder and endurance athletes alike use CapTri® to increase energy for tremendous workouts. It's an additional energy source that can be used in the presence of carbohydrates to keep you going harder for a longer period of time.

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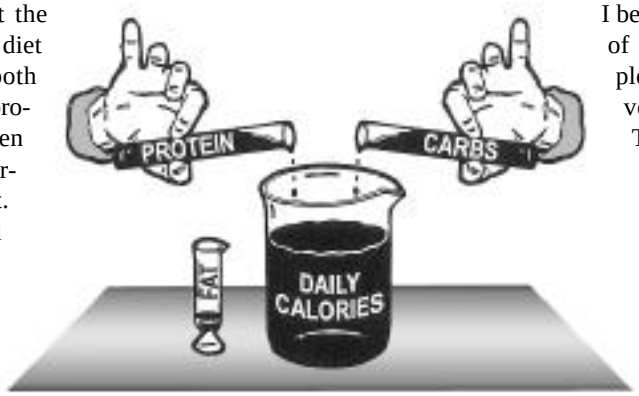
Carbohydrates: Mega Fuel For Growth and Energy, Part I

by John Parrillo

Some debate has appeared in the bodybuilding magazines recently about what's the best dietary fuel for bodybuilders. Some people are advocating the high-fat diet, in which most of the day's calories are derived from fat while keeping carbohydrate consumption to a minimum. The rationale for this approach is to avoid carbohydrates in order to keep insulin levels as low as possible, thus promoting use of stored body fat as energy. This is a topic near and dear to my heart, so let's take a close look at the facts.

Let's begin our analysis with the most basic concepts and move to more specific considerations later. What the high-carb diet and the high-fat diet have in common is that they both emphasize consuming adequate protein to maintain positive nitrogen balance. This is the first consideration of any bodybuilding diet. Many studies have documented that bodybuilders and endurance athletes need a lot of protein to make up for the loss of amino acids which are oxidized as fuel during exercise and to repair muscle tissue which is damaged during exercise. (See the July '95 issue of The Parrillo Performance Press for an extensive reference list.) Most bodybuilders do well on one gram of protein per pound of body weight per day, while others may need as much as one-and-a-half or more. The primary function of protein in the diet is to supply amino acids which are used to support protein synthesis in the body. This is required to repair muscles that are damaged during exercise, to support growth of new muscle tissue, and to allow for protein turnover, which is the replacement of all sorts of cellular proteins that "wear out" from every day wear and tear.

The rest of your daily calorie intake is to provide energy, and this is where the two diets differ. One strategy is to supply most of this energy in the form of complex carbs, while the other approach is to supply the energy as fat. The truth is that either approach can be made to work, and the question is which one works best? To promote the use of stored body fat as energy the one crucial requirement which must be met is the body must function in a net energy deficit. This means that energy consumed (dietary calories) must be less than the total amount of energy (calories) the body expends. Only when your body burns more calories than you consume will it draw on stored fat for energy. This is a fine line to walk, however, because if the energy deficit is too great you will also draw on stored protein from skeletal muscle and internal organs for energy. This is why it's important to keep protein intake high while losing body fat, to minimize these losses. If you are familiar with my program you know that I do not advocate cutting calories to lose weight, since this slows your metabolic rate and sets into play an adaptive response that actually causes your body to hoard fat at the expense of protein (1,2). (The biochemistry and endocrinology of this were explained in detail in previous issues.) A much better way to achieve an energy deficit is to increase your energy expenditure by doing more aerobic exercise.You burn fat while doing the aerobics and burn more fat afterwards because your metabolism has increased.



So to lose body fat while maintaining muscle mass we need to consume a diet adequate in protein and deficient in calories (that is, we need to burn more calories than we consume). After meeting the protein requirement, the rest of the calories can come from carbohydrates, fat, or some combination. Just so we burn more calories than we eat, we will lose body fat. So both diets will work, but that's not to say they work equally well. I believe that it is best to supply the bulk of dietary energy in the form of complex carbohydrates and to keep conventional dietary fat to a minimum. Three general categories of reasons have lead me in this direction: personal experience with real-life bodybuilders, general health considerations, and the scientific literature. The simple truth is that the vast majority of bodybuilders stick to the high-carb approach because they have found it works better for them. Almost all of the professionals I've trained just seem to do better on the high-carb/low-fat diet. Believe me, what matters at this level is results. If the high-fat diet gave better results, that's what I would use. But the fact is that in my experience with elite athletes the high-carb diet works better. That's not some fancy technical explanation, it's just the bottom line, plain and simple.

The second reason I favor the low fat approach is for general reasons of good health. The number one killer of people in this country is heart disease, which accounts for as many deaths as all other causes of death put together (including cancer). Coronary artery disease occurs when cholesterol plaques build up inside

the arteries supplying the heart muscle, cutting off some of its blood supply (3). When the heart muscle can't get enough oxygen angina (chest pain) occurs. Sometimes the cholesterol plaques rupture (break), causing a blood clot to form in the coronary artery. This completely cuts off blood supply to part of the heart resulting in myocardial infarction, or a heart attack. Doctors and nutritionists all suggest following a low fat diet to help reduce blood cholesterol level and prevent coronary artery disease. A diet high in conventional fat has also been associated with some cancers, including breast cancer and colon cancer (3). Furthermore, doctors and nutritionists suggest eating a low-fat diet to help lose weight, because gram for gram fat contains more than twice as many calories as protein or carbohydrate, so cutting down on fat is the easiest way to cut down on calories. So from the point of view of general health concerns, such as heart disease, cancer, and obesity, eating a low-fat diet seems to be the way to go.

Finally, there is quite a body of research literature supporting carbohydrates as the preferred energy source for athletes (see chapters 2,3, and 7 in reference 4). In contrast, I don't know of any scientific studies which have found conventional fat to be a superior energy source for athletes. As you know, weight lifting is an anaerobic activity. That means the energy is produced without using oxygen. Carbohydrate is the body's preferred fuel substrate which can be broken down to yield energy without reacting with oxygen. Here's what's going on: Let's say you're doing a set of bench presses to failure, and you can get 8 reps with 225 pounds but you fail on the ninth rep and your training partner has to help you rack the weight. Your pecs are working as hard as they can for about 30 seconds and then they give out and can't do another rep. They fail because they run out of energy and because waste products accumulate which inhibit further contraction. While this is happening blood is flowing to the muscle supplying it with nutrients and oxygen. The problem is the blood can only flow so fast, so there's a limit to how fast it can supply fuel and oxygen. Furthermore, it takes some time for these chemicals to move from the bloodstream into muscle cells.

When you go for a walk there's no problem supplying oxygen and fuel fast enough to keep up with the demands of your leg muscles. This is a low intensity exercise and you can keep it up for hours because the blood flow is adequate to supply the muscles with fuel and oxygen as fast as it's being used. Weight training, on the other hand, is very intense and the muscles are performing work at the fastest rate they can. This means they are consuming energy as fast as they can—faster than can be supplied by the bloodstream. So during a set the muscles rely

on fuel already stored inside the cell. The first few seconds are fueled by the phosphate energy system, ATP and creatine phosphate. After that muscle glycogen is broken down to pyruvate and then to lactic acid without reaction with oxygen. This biochemical pathway is called glycolysis, and is a way for muscles to perform work faster than would be possible if they had to wait for oxygen to be delivered by the blood. The glycolytic pathway can supply energy for a minute or two, until energy substrates within the cell are depleted and waste products accumulate.

The point of all this is that fat cannot be readily used as a fuel for lifting weights because fat REQUIRES oxygen to be broken down (3,4). Carbohydrates are essentially the only fuel your body can use to lift weights, because it's the preferred fuel the muscles can break down without using oxygen (4). So right off the bat there's a pretty good reason why bodybuilders should eat a high carbohydrate diet. How can people on the high fat diet still manage to lift weights? Because they are breaking down protein and the amino acids are converted to glucose in the liver in a process called gluconeogenesis. To me it makes more sense to let dietary protein be used as protein instead of being converted to glucose (a simple carbohydrate) so it can be used as fuel. If your body requires carbs to lift weights, then feed it carbs. Is that so complicated?

So high intensity exercise such as lifting weights is fueled almost exclusively by carbohydrates, while low intensity exercise like walking or riding the stationary bike can be fueled by carbs or fat. This is why I recommend aerobic exercise for bodybuilders: fat oxidation is by necessity an aerobic activity, so this makes aerobics the best way to lose body fat. If you're going to do some aerobic exercise activity to burn fat, why supply fat in the diet? Would you rather be burning fat that you just ate or stored body fat? It makes more sense to me to supply dietary energy in the form of carbohydrates, which can be used as fuel for weight training, and to burn body fat to fuel my aerobic exercise. Why burn 300 calories worth of fat on the stationary bike and then turn around and eat 300 calories worth of fat your next meal? That just puts the same amount of fat right back into your system. Keep in mind that fat cannot be converted into carbohydrate. (Technically speaking, fatty acids cannot be converted into carbohydrate, but the glycerol backbone can. This only represents a few percent of the calories in a triglyceride molecule however.) So you cannot use fat to replenish glycogen stores. Neither can fat be converted to protein. Dietary fat can do two things in your body: it can be

burned for energy or it can be stored as body fat. So if you want to try the high fat diet just keep in mind that you have to burn off all those fat grams or else store them in adipose tissue. They can't end up anywhere else.

Besides providing energy substrate for weight training, there are several other advantages to supplying the bulk of dietary energy as carbohydrate instead of fat. First is that excess carb calories are used to replenish glycogen stores before they are converted to fat. Remember, you can convert carbs to fat, but not fat to carbs. If you're on the high fat diet and consume too many calories, the excess will appear as body fat. That's the only metabolic fate available to it. On the other hand, if you consume excess calories on the high carb diet the excess carbs will be converted to glycogen and stored in the muscles and liver. If the glycogen stores are filled up and you still have more excess carb calories around, then they will be converted to fat and stored as adipose tissue. Remember, too many calories from any source can make you fat. The silver lining to this black cloud is that converting a carbohydrate molecule into a fat molecule takes some energy. In fact, about 25% of the energy in a carbohydrate molecule is spent in the process of digestion, assimilation, transport, and conversion to fat. In contrast, only about 3% of the energy in dietary fat is used to get it from your mouth to your waist. Calories from dietary fat are thus stored as body fat much more efficiently than are calories from carbs. Again, carbs sound like a better deal to me.

What got this debate started was the idea that by lowering carbs we could lower insulin. Since insulin promotes fat storage and blocks fat breakdown, this seems like a good idea. What if I told you how to keep insulin levels low but still consume a high carbohydrate diet? Sounds like the best of both worlds. The first thing to do is to choose only complex carbohydrate sources and to avoid simple sugars. The trick is to combine the foods you eat at each meal so you get a slow release of carbohydrate into your system so it won't be turned into fat. Each meal should contain at least one serving of fibrous vegetables, which are digested and released into the blood slowly. Also, by combining your carbs with protein and CapTri® you can further slow the release of carbs. By proper meal combining, as outlined in the Parrillo Nutrition Manual, you can eat a diet high in complex carbohydrates and low in fat and still keep insulin at a steady, low level. Finally, our carbohydrate supplement "Pro-Carb™" is specially formulated to be slow releasing, based on a complex carbohydrate powder called maltodextrin. We've blended 4 grams of protein along with 22 grams of carbs into each serving, which further slows digestion. The product contains no sugar or artificial sweeteners. It is fortified with amino acids which are required in increased amounts during periods of rapid growth. Pro-Carb™ is the ideal supplement to supply high quality complex carbohydrates in a form that digests slowly, thus minimizing the tendency to store as fat. Unlike the other carb drinks on the market, ours contains no sugar. Pro-Carb™ is an excellent way to supply carbs to fuel your workouts, and works very well to replenish glycogen stores after training. Take one or two scoops 30-60 minutes before you train and again immediately when you finish your workout, and see your intensity and recovery ability skyrocket. Pro-Carb™ also is an excellent supplement to add quality calories to your meals when you are trying to gain muscular weight.

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Carbohydrates: Mega Fuel For Growth and Energy, Part II

by John Parrillo

Last month I explained why the latest diet craze —the high fat diet—doesn't make any sense. It can contribute to heart disease and cancer. It deprives your muscles of carbs which they require for high intensity exercise like weight lifting. And if you are eating extra calories to gain lean body mass, excess fat calories have a very high tendency to be stored as body fat. Remember, fat cannot be converted to muscle and it cannot be stored as glycogen. The only thing your body can do with excess calories from conventional fat is to store them as body fat.

The theory behind the high fat diet is to use dietary fat as fuel in place of carbohydrates. This results in lower insulin levels. Since insulin stimulates fat storage and blocks fat breakdown, this sounds like a good idea. If we could get around the problems with the high fat diet, it would be great. And we can with CapTri®! The Parrillo diet is very low in conventional fat but instead relies on a special fat called CapTri® which has been specifically formulated for bodybuilders and anyone trying to minimize body fat stores. The Parrillo diet is a more balanced approach, and I think you'll agree makes a lot more sense. The first consideration is to meet your protein requirement. A good rule of thumb is one gram of protein per pound of body weight per day. Divide this equally among six meals spread throughout the day. Next comes CapTri®. Start out with ½ tablespoon per meal, mixed with food, until your system gets used to it. Work your way up to one or two tablespoons per meal, depending on your size and level of caloric intake (some people eat as much as five tablespoons per meal). A good rule of thumb here is to try to derive 30% of your calories from CapTri® while limiting conventional fat to 5% of calories. You should see and feel a dramatic effect at this level. Then make up the rest of your calories from unrefined, complex carbohydrates. Avoid simple sugars, fruit, dairy products, bread, pasta, and other refined carbohydrates. These carbohydrate sources will make you fat. I classify carbs into three groups: simple sugars and refined carbohydrates (one group), starchy carbs, and fibrous carbs. Good starchy carbs are potatoes, sweet potatoes, rice, beans, peas, corn, and oatmeal. Good fibrous carbs are vegetables like lettuce, spinach, cabbage, green beans, and so on. The Parrillo Performance Nutrition Manual contains an extensive list of good foods to eat along with their nutritional content.

How does this compare with the high fat diet? There are two big differences. First, the Parrillo diet uses CapTri® instead of conventional fat. Whereas regular fat found in conventional food has a very high tendency to store as body fat, CapTri® does not. CapTri® is a fat with a specially engineered molecular structure that causes it to be metabolized differently than regular fat (1-7). CapTri® has almost no tendency to store as body fat (1-7). Instead, excess calories from CapTri® are simply released as body heat in a process called thermogenesis (1-7). This is really a bodybuilder's dream since it allows us to substitute fat calories for carbs in order to decrease insulin levels, while avoiding the pitfalls of regular fats. The second big difference is that on the Parrillo diet you never go real low on carbs. The way the diet is structured, you don't have to. The high fat diet calls for limiting carbs to 5-10% of calories so that you can enter a fat-burning state called ketosis. With the Parrillo diet you can maintain insulin at low levels and shift your metabolism into a fat burning mode, all while still consuming 40-60% of your calories from carbohydrates. This works because combining protein and fat (CapTri®) and fiber at each meal slows the release of carbs into the bloodstream, resulting in a much lower insulin level.

This approach is far superior to the high fat diet because it supplies the carbs your body needs for top performance. If you've ever tried going low on carbs, you know what I mean. You just don't have the energy without carbs. As I explained last month, weight lifting is a form of anaerobic (without oxygen) exercise. This means that your muscles are working so hard and so fast that the energy requirement cannot be met by the aerobic (with oxygen) energy pathway. The preferred fuel for your muscles to use during anaerobic exercise is carbohydrate. So does it make sense for bodybuilders to go really low on carbohydrates? I don't think so.

> Fat cannot be converted to muscle and it cannot be stored as glycogen. The only thing your body can do with excess calories from conventional fat is to store them as body fat.

Let's take a look at some of the other benefits of carbohydrates. Everyone knows

by now that diets based on severe caloric restriction fail (8,9). They fail because the body reduces its level of energy expenditure to compensate for the loss of incoming energy (calories). During very low calorie diets about half the weight which is lost is muscle. And since muscle is the metabolic engine where a lot of calories are burned, if you lose muscle you burn less calories. The number of calories your body burns per hour while you are at rest is called your basal (baseline) metabolic rate (BMR). It has been shown that BMR increases following excess feeding of a mixed diet (i.e., a normal diet that contains carbohydrates) but not if only excess conventional fat (LCT) is fed (8). This means that carbohydrates increase your metabolic rate more than conventional fats do (but not more than CapTri®). How does this happen? It turns out that carbohydrate is converted to ATP (energy in the molecular form which is usable by cells) with an overall efficiency of 75% (8). The other 25% of the calories in the carbs gets released as body heat in the process. Fat is converted to ATP with an efficiency of 90% (8). This means that if you feed your body carbohydrates instead of fat a higher percentage of the calories you eat will be converted to heat, which translates into a higher metabolic rate. The more calories you eat which are lost as body heat, the less left to store as fat. In simple terms, this is just saying that eating a high carb diet instead of a high fat diet results in a higher metabolic rate, meaning that your body burns more calories all the time, even when you're at rest. These calories which are being burned simply appear as body heat.

Now keep in mind that this does not apply to CapTri®, which is a specially designed MCT. CapTri® is a fat, but follows a different metabolic pathway from regular fats. It's a whole other animal. CapTri® increases metabolic rate even more than carbohydrate. It's jet fuel for muscles.

For you biochemists out there who want to know how carbohydrate feeding stimulates metabolic rate: The thermic effect of food (TEF) is defined as the postprandial increment in energy expenditure above the resting rate and is expressed as a fraction of the energy content of the food consumed (8). A substantial part of the TEF (50-75%) is simply the energy used to digest, transport, and store food (8). This is termed the obligatory component of TEF. Carbohydrate feeding is known to stimulate the sympathetic nervous system, and the ensuing catecholamine-mediated increase in metabolic rate is known as the facultative component of TEF (8). This effect can be blocked by propanolol (a beta-adrenergic antagonist).

From this we can see that body weight, and body composition, depend not only on energy balance (calories in versus calories out) but also on what foods you eat. A person eating a high carb diet will naturally burn more calories than someone eating a high

fat diet, because he has a higher metabolic rate. This will make it easier for the person on the high carb diet to stay lean. I think it was explained very well in Bjorntorp and Brodoff's classic text "Obesity" (8) when they pointed out that the human body very narrowly regulates carbohydrate stores but not fat stores. The body has a limited ability to store carbohydrate (glycogen). The adjustment of carbohydrate oxidation to carbohydrate intake is carefully controlled to result in stable glycogen reserves under a wide range of dietary carbohydrate intakes. This means that if you eat more carbs you burn more carbs, and if you eat less carbs you burn less carbs. This is because it is so important to maintain blood glucose levels to allow proper brain function. On the other hand, body fat stores are not regulated in this way and your body has an almost limitless potential to store fat. You can only store 400-600 grams of carbs no matter how much carbs you eat, but you can store 100 pounds of fat (or more) if you eat enough. Thus, carbohydrate feeding promotes carbohydrate oxidation (burning) but fat feeding does not promote fat oxidation (8). On days when excess carbs are consumed carbohydrate oxidation is increased, but if excess fat is consumed it is simply stored in adipose depots (8). Since 25% of excess calories from carbohydrate are wasted as heat, and since glycogen stores are generally far from full, an excess carbohydrate load of 500g can be accommodated without an increase in body fat (8). This means if you over-eat on the high carb diet the excess carbs get stored as glycogen, but if you over-eat on the high fat diet the excess fat gets stored as body fat. Excess fat calories are not released as body heat, and they cannot be converted to glycogen or muscle. Bummer.

These arguments show that a meal with a high carbohydrate to fat ratio is more thermogenic than a meal with a low ratio. While carbohydrate and protein balance are closely regulated, fat balance is related by the amount of fat in the diet (8). During overfeeding, weight gain is closely related to fat intake (8). The body's inability to regulate fat stores explains why the incidence of obesity rises as the fat content of the diet increases (8). Is this starting to make the high fat diet sound a little less attractive?

Now don't go crazy on this information and get the idea you can indiscriminately eat all the carbs you want and never get fat. It just isn't so. After glycogen stores are full, any more excess carbs get converted to fat and stored as fat. Your body is very good at converting excess carbs into body fat. The point is that body fat accumulation is less likely with the high carb diet than the high fat diet, but it is possible with any diet if you consistently consume too many calories. I'll reiterate the most important guidelines are to avoid simple sugars and refined carbohydrates. These generate a greater insulin response and therefore are a more potent stimulus for fat storage. Simple sugars are present in sweets and desserts (obviously) and are also found in significant quantities in fruit and dairy products. Pasta and bread are made from refined carbohydrates (sorry, but this includes bagels). Also, but sure to mix

your carbs with protein at each meal, and include a fibrous carb with each starch. These things slow the entry of glucose into the blood.

The down side of carbs, as proponents of the high fat diet are quick to point out, is that they induce a big insulin response. This is why I've gone to such pains to structure my diet the way I have, using only slow-release complex carbohydrates. If you eat as outlined in the Parrillo Nutrition Manual, you'll be able to eat a high carb diet while minimizing insulin response. This is also why my carbohydrate supplement, Pro-Carb™, is formulated the way it is. It is based on maltodextrin, a slow release glucose polymer with a glycemic index of 22-26. This is just about as low a glycemic index a carb can have. Plus I've added 4 grams of complete protein to every serving to further slow glucose release. It is sweetened with glycine, a naturally sweet amino acid, instead of sugar or corn syrup. For good glucose and insulin control, it's probably one of the best carbohydrates available. It was designed specifically for bodybuilders and athletes, with these considerations in mind.

The truth is I can see the logic of the high fat diet and I've had great success with it in bodybuilders, the main difference being I use CapTri® instead of conventional fat. The reasons for this have to do with how CapTri® is metabolized and that it has almost no tendency to be stored as body fat (1-7). CapTri® is profoundly thermogenic, meaning that it increases metabolic rate and excess calories from CapTri® are simply lost as body heat instead of being stored as body fat (1-7). This is in stark contrast to conventional fat found in regular foods, which has very little thermogenic potential and has a high tendency to store as body fat. The other main difference is that I never recommend going as low in carbs as the hard-core high fat people do. The high fat diet calls for restricting carbs to 5-20% of daily calories, depending on who you read. Once carbs get below about 100 grams a day, your body starts to break down muscle tissue and uses the amino acids to make glucose in the liver. Intentionally constructing a diet that results in muscle break-down to maintain blood glucose never made much sense to me. Losing a pound of fat doesn't really get you anywhere as a bodybuilder if you have to lose a pound of muscle at the same time. The other thing is your muscles require carbs to fuel the anaerobic activity of lifting weights. If your muscles need carbs, feed 'em some carbs. It's not that complicated.

My experience with top bodybuilders over the last twenty years has taught me that the best diet is one which provides one to one-and-a-half grams of protein per pound of body weight per day, about 30% of calories as CapTri®, and the rest as complex carbs. (And believe me, I've taken them from the basement to the Olympia, literally.) This usually works out to be around 30% protein, 30% CapTri®, and 40% carbs, but the percentages vary among individuals depending on their protein and calorie requirements. The ratios also change depending on whether you're trying to gain muscular weight in the off season or lose fat before a contest. The exact protocols are given in the Nutrition Manual.

My opinion is you're better off with a high carb diet, with or without CapTri®, than with the high fat diet. I think it works better and an overwhelming body of scientific literature backs me up. Plus, it's healthier, you feel better, and you have more energy to train.

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Parrillo Performance Nutrition Bulletin # 39

Programmed For Success: Supplementation For Optimal Results, Part I

by John Parrillo

Parrillo Performance is proud to be the only company offering bodybuilders a comprehensive program of nutrition, supplementation, and training optimized to increase muscle mass and decrease body fat. Our program is about results— that's the bottom line. It's unfortunate that so many people work out in the gym and try to watch what they eat, but just never seem to get the results they're looking for. Usually it's because they've left out some part of the formula that's required for success. How many people in the gym where you workout have truly impressive physiques? Probably not many. If you don't have the body you want or if you're not making good progress, that means you're doing something wrong. Most people take the approach of trying this and trying that, reading muscle magazines and talking to their friends in the gym, hoping that sooner or later they'll find something that will work. The single most valuable service we offer is our information, and that's probably what sets Parrillo Performance apart more than anything else. Parrillo Performance makes bodybuilders by teaching people how to become bodybuilders. You can't get that anywhere else.

Pick up any bodybuilding magazine and you'll find ad after ad promising that a certain supplement will transform your physique. A lot of young bodybuilders get trapped in the mentality of searching for that magical supplement that will pack pounds of muscle onto their bodies. I'll tell you up front it doesn't work that way. If developing a championship physique was as easy as taking supplements you'd see a lot more impressive physiques in the gym. Sure, supplements can help, and we offer, without doubt, the most effective supplement line on the market. But still, supplements are only part of the picture.

Bodybuilding is hard work—in and out of the gym. Your work in the gym is only the beginning. What is bodybuilding about, after all? It's about taking an ordinary body, or even a less-than-average body, and turning it into something special— something beautiful. That isn't easy. In my business, I've been privileged to see many remarkable transformations, in people of all ages. Seeing people make positive changes in their lives and achieve their goals is my greatest reward.

I do this because I love bodybuilding and I love to see people get results. We'reabout education and information because people need the information to get results. That's why I publish this magazine I publish this magazine. As you might imagine, this is a tremendous expense that eats a huge chunk out of my profits, but I want to stay in touch with my clients and continue to bring them up-to-date scientific and practical information. That's the way I want to do business. I have a scientist on staff with a Ph.D. in molecular biology to help us with research in nutrition and metabolism. I sent him to medical school and in a few months we'll be proud to have an MD on staff. And it's all done in the interest of increasing the knowledge of maintaining a healthy human body.

Bodybuilding is about mastery. Mastery of your body and your life. It's about discipline and self control. It's using your mind to control your body, to make it what you want it to be. And before you can use your brain to transform your physique into that of a bodybuilder, your brain has to know what it's doing. That's where I come in. I teach people what to do to become bodybuilders. The sense of mastery, of controlling your life and your destiny, is to me what bodybuilding is really about. (And you thought it was just about lifting weights!) People develop a sense of self-worth or self-esteem when they set a goal for themselves and follow through on it. Bodybuilding is a journey. Your destination may be to become a top amateur or professional bodybuilder. Or a fitness star. Or a model. Or the best looking guy on the beech. Or just to finally lose that weight and get in the best shape of your life. Like any journey, you take it a step at a time. You set a goal and then plan out a strategy, or road map, to get you from where you are to where you want to be. The Parrillo Performance Program is your road map to bodybuilding success.

The beauty of our program is that it is a comprehensive approach, and no doubt that's why it works so reliably. It includes exact instructions on nutrition, supplementation, weight training, aerobic conditioning, and stretching. The Nutrition Program comes with a food scale and instructions on how to precisely construct each meal to contain the number of calories and grams of protein, carbohydrate,

and fat you need. It includes a food composition guide listing the nutrient breakdown of the foods you should be eating. It contains instructions on how to modify your diet throughout the year to gain muscle or lose fat. It tells you how to carb load and peak for your contest. We provide a Body Stat Kit with skin-fold calipers so you can monitor your body composition. This way you can make sure you're gaining muscle and losing fat. If things aren't going the right way, the manual tells you what changes to make. The Training Manual describes the proper execution of the most effective bodybuilding exercises, has suggested routines, and tells you how to stretch each muscle group. All of this is backed up by our technical services line (513-531-1311) where you can call with any questions. We provide a comprehensive line of state of the art supplements to help enrich your diet. Call us if you have questions about which ones are most appropriate for you.

With this comprehensive approach to bodybuilding, we leave no stone unturned. Every element of the program has been tested on top level bodybuilders many times over. During the last twenty years I've done just about every experiment with training, nutrition, and supplementation you could imagine. The program is polished and honed—and it works. All of the guesswork is removed. It truly is a formula for success.

My philosophy basically is that, if you work hard, you deserve to be rewarded with results. To achieve a top level bodybuilding physique is not easy. As with any worthwhile goal, it requires dedication, consistency, and hard work. If you make a commitment to those ideals and put forth the effort, I'll make the commitment to teach you what to do to become your best. I'm a trainer of competitive bodybuilders, and over the years I developed my own line of supplements because I saw in my athletes a need for better products. I was training competitive athletes and experimenting with nutrients a long time before my supplement line came out. I'm a trainer first, and the knowledge of what to do is much more powerful than any supplement could ever be. Parrillo Performance is here to teach serious athletes what to do to become their best. I've helped more than a few bodybuilders move up to the professional ranks.

Over the last few years I've written a lot of articles detailing the science behind the program. We've talked about hormones and how to control them with diet, metabolism of fat, muscle physiology, exercise physiology, biochemistry of nutrients, energy metabolism, and other topics that represent why the program is the way it is. The practical "how-to" information is spelled out in detail in the Nutrition and Training Manuals. What I'd like to do now is give kind of an overview of the program that integrates some of the technical information with the practical information.

The basic premise of the Parrillo Nutrition Program is that healthy foods are the foundation of nutrition. This is in stark contrast to the other companies, who want you to believe that their product is the magical key to success. Supplements can help, but remember that they're supposed to be used to fortify or enhance your diet. Supplements cannot redeem a bad diet. In other words, a bad diet plus supplements is still a bad diet. Properly used, supplements can boost the levels of specific nutrients beyond what can practically be obtained from whole foods alone. So let's start with the diet. I advocate a diet low in fat, medium in protein, and high in complex carbohydrates. The way to calculate your diet is simple. Research has shown that intensely training athletes need about one gram of protein per pound of body weight per day to maintain nitrogen balance (1). That means they need that much protein to unsure they have enough to build muscle mass. This amounts to about 2.5 times the RDA for protein, which is based on non-exercising people. For years there was a lot of controversy on this issue, but now it is well understood that intense exercise training increases a person's need for protein. During dieting I suggest you increase protein intake to 1.5 grams per pound of body weight. Here's why: Some of the protein you eat is burned for energy. During extreme conditions, such as starvation or prolonged endurance exercise, the protein in your muscles can even be broken down and used for energy. Any form of calories provided by the diet is said to "spare" protein, meaning that the more calories you have coming into your body the less protein it needs to burn (2). When you're dieting to lose weight for a contest you will be consuming less calories than during the off season. This increases the chances your body will use some protein as fuel. To make up for this you should increase protein intake when you reduce calories.

So start with one gram of protein per pound body weight in the off season or 1.5 grams pre-contest. The next step is to limit fat to 5% of daily calories. The rest of your calories come from complex carbohydrates. That's a pretty simple formula. It's impossible to accurately break this down into percentages of calories from protein, carbohydrate, and fat because the numbers work out to be different for every one. As an example, a bodybuilder weighing 200 pounds and consuming 3,000 calories would consume 200 grams of protein, 17 grams of fat, and 510 grams of carbs. This would be 27% protein, 68% carbs, and 5% fat. (Remember that protein and carbohydrate have 4 calories per gram and fat has 9 calories per gram.) The ratios usually work out to be 25-30% protein, 60-65% carbs, and 5-10% fat for most people. The basic rationale is this: The role of protein in the body is to support your lean body mass and to provide the raw materials you need to build more muscle. So protein requirements are determined by body mass. As your muscle mass increases, your protein requirement increases. The role of carbohydrate is as a fuel source, so carbohydrates are used to supply the bulk of calories. The carbohydrate requirement is determined by daily energy (calorie) needs. Dietary fat is kept to an absolute minimum. Study after study has shown that body fat is more closely determined by dietary fat content than by dietary energy content (2-5). In other

words, how fat you are is determined by how much fat is in your diet, and this is more important than how many calories you eat. Dietary fat has a strong tendency to be stored as body fat, whereas lean protein and complex carbohydrates do not (2-5). Excess calories from protein and carbohydrate tend to be lost as body heat instead of being stored as fat (2-5). Excess calories from dietary fat are simply retained as body fat (2-5). Consider this: metabolic studies have shown that your body is constantly burning a mixture of carbohydrate and fat for energy. At rest, most of your energy is derived from fat. As activity level increases, more carbs are thrown into the furnace. So your body burns a certain amount of fat every day as fuel. What would happen if your diet supplied less than this amount? You will burn body fat, that's what. There are several things about the low fat diet that make it perfect for bodybuilders. I'll get back to that in the future.

One of the toughest questions is, "How many calories should I consume?" This is a very individual thing, and is determined by your lean body mass, activity level, and genetics. There are several mathematical formulas you can use to estimate your maintenance requirements, but I'm not going to list them here because they don't work reliably. The individual variation is tremendous. The easiest and best way to handle this is simply to start weighing your food and use the Food Composition Guide in the Nutrition Manual to calculate how many calories you normally consume. Keep a food journal and write down every bite of food you eat. After a week or so, average your daily calorie intake and this will give you a good idea of how many calories you need to maintain your present lean body mass. You can adjust this up or down by 300-500 calories per day depending on whether you want to gain weight or lose weight. Remember that muscle tissue is constantly burning calories to maintain itself, even at rest. So as your muscle mass increases you'll need to slowly and continually adjust your calories upward. As your muscle mass increases your metabolic rate increases, so your calorie requirements increase too. I call this "building your metabolism." I introduced this concept six or seven years ago and it revolutionized the way people thought about bodybuilding nutrition. Since then it's caught on in the popular diet literature too, and now you see info-mercials on TV about it.

You need to feed your body and supply it with all the nutrients it needs to be healthy—even when you're dieting to lose weight. Caloric restriction sets off a starvation response that shuts down your metabolism to save fuel. By increasing muscle mass you can build your metabolism so that you constantly burn more calories. And by restricting dietary fat you can force your body to burn its own fat for energy. There are also some highly technical aspects about how various fuels are metabolized by your body that factor in here. I explained these concepts in my series about thermogenesis a couple years ago. The bottom line is that the Parrillo diet increases metabolic rate by fostering muscle growth, as well as by direct thermogenic effects of the nutrient profile.

So we've talked about how many calories to consume and how to divide those up among protein, carbohydrate, and fat. The next major concept is how to structure your meals. Simply put, you should divide your daily requirements for calories, protein, carbs, and fat into six equal portions and eat six small meals spaced about three hours apart throughout the day. An important part of the diet is its effect on hormone levels, especially insulin, glucagon, and growth hormone. The diet is specifically designed to control these hormone levels to maximize muscle mass and minimize body fat. It won't work if you eat only protein at one meal and only carbs at the next meal. Each meal must be properly balanced. Also, it's important not to eat too many calories in any one meal. Six small meals will make you much leaner and more muscular than three large ones, even if you consume the same total number of calories during the day. Too many calories at one meal will elevate insulin levels too high and will promote fat storage. Also, muscle can only grow so fast and it does better with a more constant and uniform supply of nutrients instead of three big doses. Another important factor is the thermic effect of feeding, or TEF. Every time you eat, your metabolic rate increases as a result of stimulation of the sympathetic nervous system by nutrients and by hormones released from the gut after feeding (2). Frequent, small feedings increase TEF and decrease fat storage. The only time to change this is the last few weeks before a contest you may want to decrease carbs in your last meal of the day to promote fat burning at night, but that's a small technical point we don't need to worry about now.

Finally we need to talk about which foods to eat and which foods to avoid. The best lean protein sources are skinless chicken breast, skinless turkey breast, egg whites, and most fish (including tuna packed in water). Carbohydrates are divided into two groups: starchy and fibrous. Good starchy carbs include potatoes, sweet potatoes, rice, beans (all vari-

eties are okay), lentils, corn, peas, oatmeal, grits, and cream of wheat. Fibrous carbs are basically any and all fresh or frozen vegetables. Examples are salad greens, lettuce, spinach, broccoli, cauliflower, asparagus, cabbage, eggplant, mushrooms, onions, peppers, tomatoes, carrots, celery, and so on. Each meal should contain one serving of protein, one serving of starchy carbohydrate, and one fibrous vegetable, in the appropriate ratios. Combining fiber and protein with the starch slows the rate of glucose release so you get a slow, steady insulin release, which helps channel the calories to muscle and not fat. If you combine your foods in this way you really don't have to worry about glycemic index. White potatoes have a relatively high glycemic index when eaten alone, but when combined in a meal like this the overall glycemic index of the meal is very low. As far as dietary fat goes, you don't have to add any fat source at all to the diet. Your 5-10% fat calories will come along naturally with the other foods. You may want to add one teaspoon to one tablespoon per day of flax oil to provide essential fatty acids (EFAs), or take an EFA supplement such as evening primrose oil. Fish oil supplements (for the omega-3 fatty acids) are fine too, but you won't need these if you eat fish several times a week.

You'll notice these are all whole, natural, unprocessed foods. You'll get much better results eating healthy foods like this that you prepare yourself. Part of the commitment to this program is the willingness to fix your own food and take it with you in a cooler where ever you go. At first this will be a major chore, especially if you're not used to weighing your food and calculating its nutrient values. For the first month or so this will take more time than working out. Soon, however, you'll learn what portions you need and the process will become second nature. An experienced bodybuilder may even spend less time on food preparation than the average person, and yet construct precisely engineered meals. It just takes a little practice. The results will make it worthwhile, believe me. You can prepare meals in bulk and put them in Tupperware dishes in the freezer, so all you have to do in the morning is throw a few bowls in the cooler.

To attain the physique of your dreams, one of the sacrifices you have to make is to avoid certain foods. I wish I could say all things are okay in moderation, and there are no forbidden foods, but it just isn't so. Foods you should avoid are butter, margarine, mayonnaise, salad dressings, oils, shortening, nuts, seeds, peanut butter, jelly and jam, all sweets, desserts, candy, cake, pie, cookies, muffins, ice cream, pizza, cheese, hamburger, hot dogs, processed meats and deli meats, olives, avocados, crackers, pretzels, and chips. You should avoid all fast food, junk food, convenience food, snack food, all fried food, and anything in a vending machine. In general you should not eat in restaurants. It is possible to get a low fat meal in a restaurant, but difficult. You should avoid refined carbohydrates such as bread and pasta. You should also avoid fruit and dairy products (including low fat dairy products) because they derive most of their calories from simple sugars. Bread, pasta, fruit, and dairy products are perfectly healthy foods and they're great for most people, but they just don't work for bodybuilders. You're better off with unrefined, unprocessed, natural, complex carbohydrates.

This sounds like a long list of "don'ts" but you'll see what they have in common is they are all either high in fat, sugar, salt, or refined carbohydrates. These are things you want to avoid to be healthy anyway. Please notice that if you omit fruit and dairy products from your diet you'll have to take a vitamin and mineral supplement. These are the only supplements which are truly required on the Parrillo diet. Pay special attention to get enough calcium. You need 1,000 mg per day, and the typical one-a-day formulas out there don't come close to that. The Parrillo Performance Essential Vitamin and Mineral Electrolyte Formulas were designed specifically for bodybuilders following this diet. Four tablets of the mineral formula per day will meet your calcium requirement.

So that's a summary of how many calories to eat, how much protein, carbohydrate, and fat to eat, how to divide it up into individual meals, how many meals to eat, which foods to eat, how to combine foods at each meal, and which foods to avoid. Like I said, Parrillo Performance is about information. If you want a champion level physique, I can teach you what to do to get it. The Nutrition Manual is available for those who want more information and more detailed instructions. It comes with a food scale and a food composition guide, so you can construct meals precisely to meet your exact nutrient needs. It also contains a lot of sample diets, with all the calculations already done for you. Until next month— happy eating!

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Parrillo Performance Nutrition Bulletin # 40

Programmed For Success: Supplementation For Optimal Results, Part II

by John Parrillo

In the last bulletin I presented a general overview of the Parrillo Nutrition Program, and this month I want to extend that discussion by talking about strategies to maximize your results by adding nutritional supplements to your diet. People often ask if nutritional supplements are necessary.

The answer here is based on an individual's diet, training intensity and goals. If you are eating a well-balanced diet, supplyling all the nutrients your body needs through food, and your level of training activity is such that you never deplete certain nutrients, you may find that supplements are not necessary. However, many people, whether they are eating healthy or not, do not receive all the nutrients necessary to support intense training and growth. And that extends all the way to the bodybuilder, whose nutritional needs far exceed those of the average, sedentary person. So supplements can be used to prevent deficiencies in the diet. But there is still another level of supplementation. That is, are supplements required to achieve optimal results? Are supplements needed to reach your ultimate potential? The answer to this question for most hard-training athletes is yes!

Few bodybuilders (if any) make it to an advanced level without using nutritional supplements. They can't afford not to. Let's face it, if two men eat the same diet and train the same way, but one of them enriches the nutrient density of his diet by adding high quality supplements, which one do you think will get better results? When you're training that hard and that much, you're really pushing your body to it's limit. The goal in training is to apply a maximum stress, so that your body is forced to adapt and grow. This kind of training pushes your recovery ability to its limit, and your ability to recover is what determines how fast you can grow. Rest and nutrition are what your body needs to recover from intense workouts. Supplements allow you to increase the cellular levels of nutrients beyond what can be obtained from whole foods alone. Supplements are simply ultra-concentrated nutrients, and adding them to a healthy diet of natural foods increases the nutrient density of your diet. It makes sense that increasing the amount of nutrients delivered to your muscles will help them recover and grow faster.

When I started putting together my formulas for supplements, I conducted my own experiments with bodybuilders and other athletes. During this experimentation process we introduced certain nutrients into the athletes' diet, then pulled them back out, all the while noting the action and reaction this had in their training and physique. This is how I found out what worked and what didn't in competitive athletes. Nothing fancy, just simple trial and error. But by trying different combinations of nutrients, we were able to optimize the formulas for maximum effect in lean muscle mass.

To incorporate supplements into your diet, Essential Vitamin Formula™ and Mineral-Electrolyte Formula™ are the starting point. My vitamin and mineral formula is the only one designed to be taken at each meal. One reason I did it this way is very simple: Since you need the vitamins and minerals to assist and control the molecular processes associated with metabolizing and synthesizing food, it only makes sense that you provide those vitamins and minerals with the food you are eating. Makes sense, right? Another reason I did it that way was because the water soluble vitamins (the B group and vitamin C) are excreted from your body in your urine within 3-4 hours after you take them, so levels drop back down again. By taking vitamins with each meal, this provides a more steady and constant blood level. It also ensures you'll have all the vitamins around you need to help incorporate dietary protein into new muscle tissue after each meal. This makes more sense to me than taking a huge dose of vitamins every morning and excreting most of them by noon. Each Mineral-Electrolyte™ tablet contains 250 mg of calcium per tablet, so that by taking four a day you can meet the RDA for calcium. I also fortified my vitamins with large amounts of the anti-oxidants: vitamin C, vitamin E, and beta-carotene. These seem to help aid recovery by neutralizing free radicals (reactive oxygen species) generated during exercise. Free radicals are reactive molecules containing oxygen, which can damage cells and protein molecules. The anti-oxidant vitamins prevent this damage by binding to and neutralizing the free radicals. Each Parrillo Essential Vitamin tablet has 500 mg vitamin C, 200 IU vitamin E, and 5,000 IU beta-carotene. Each Mineral tablet contains 25 mcg chromium picolinate to stabilize blood sugar and optimize insulin function. Again, it makes more sense to take a small dose of chromium with each meal instead one big dose once a day. Of course, our Formulas contain a complete and balanced array of all the other vitamins and minerals your body needs for optimum health and maximum gains.

The core supplements on the Parrillo Nutrition program are vitamins and minerals, CapTri®, Hi-Protein Powder™, and Pro-Carb™. These are the most important ones for gaining lean mass. Liver-Amino Formula™ could probably fit into this group as well, but is not a major source of calories. Let's talk about how to incorporate these into your diet.

CapTri® is a remarkable supplement and should be at the center of any bodybuilder's supplement program, whether you're trying to gain lean mass or lose body fat. Think of CapTri® as a source of pure energy—calories. The special thing about it is that it's

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used immediately by the body as a preferred source of energy and has almost no tendency to be stored as body fat. It's a way (and probably the only way) you can greatly increase your caloric intake without risking getting fat. That is, of course, if the rest of your diet is good. CapTri® is absorbed by the body and burned for energy almost instantly—faster, in fact, than glucose (1). Since it's converted into energy so rapidly it has virtually no tendency to contribute to body fat stores. Here's the deal: adding pounds of muscle mass to your body takes calories. You could supply the extra calories from regular foods, such as complex carbs and lean proteins. And this will work, but the problem is regular foods are more prone to be stored as fat than CapTri® is. So by increasing calories from regular food you can add muscle mass, but you're more likely to put on fat at the same time. CapTri® itself is not converted to muscle—that's not what's happening. How it works is CapTri® supplies the energy your body needs to function and the energy cost required to build more muscle. The protein foods that you eat supply the raw materials (amino acids) that are used to build new muscle. CapTri® spares the oxidation of amino acids, meaning that it blocks the use of proteins as fuel (2). This helps dietary protein be incorporated into muscle tissue more efficiently, as well as having an anti-catabolic effect to block muscle breakdown. The net result of increasing calories in this way is more muscle mass, without the increase in fat that comes from eating an excess of regular food. What happens if you eat too much CapTri®? The excess energy gets converted to body heat instead of being stored as fat. Also, excess calories from CapTri® can be lost as ketone bodies in the urine, something that doesn't happen with regular food. Start by adding one-half tablespoon of CapTri® directly to your food at each meal. Every three days, increase your intake by another one-half tablespoon, until you're gaining weight. Increasing the amount of CapTri® gradually helps avoid an upset stomach, which can occur because CapTri® is digested so rapidly. Usually between one and three tablespoons per meal works well for most athletes, although some use as much as five or six.

How can a supplement so rich in calories help you lose body fat? Simple. To use CapTri® while dieting replace some of your carbohydrate calories with an equivalent amount of calories from CapTri®. CapTri® contributes less to body fat stores than does carbohydrate, because it's immediately converted to energy without being stored by the body (1,2). Metabolically speaking, this is called the thermogenic effect. Every time you eat, some of the food energy is converted to heat. The more energy that's lost as heat, the less there is remaining to be stored as fat. Conventional fats found in regular food are not converted to heat much at all, and that's why they contribute to body fat stores so much. About 3% of the calories

in regular fat is lost as heat. About 15% of the energy from carbs is converted directly to heat, and about 20-30% of the energy in dietary protein is lost as heat. CapTri® has the most profound thermogenic effect of any food known, so it's basically all burned for energy. You may be wondering, if this stuff is just converted into energy and lost as body heat, isn't that a waste? Why not just eat less food? Two reasons. Eating less food will help you lose weight, but a significant proportion of it will be muscle mass. Also, decreasing calories slows down your metabolic rate, so you burn less calories, which means burning less body fat. The thermogenic (heat-producing) effect we just talked about actually works to increase your metabolic rate so you'll burn fat faster. Plus, as mentioned above, it blocks protein breakdown so you won't lose muscle while you're losing fat. Of course, not all of the energy in CapTri® is lost as body heat—most of it is used to fuel activity and maintenance of the body. The point is, the energy from CapTri® is more prone to be used as body heat (energy) than are the calories from regular food, which is why CapTri® is less prone to be retained as body fat than regular food. Adding CapTri® to your diet increases the thermogenic effect of feeding (TEF), and if you're producing more energy, you have a higher metabolic rate. And if you increase your metabolic rate, your body needs more energy, so it burns more body fat. By incorporating CapTri® into your diet, you're reducing what is called the "food efficiency" of your diet, which is the proportion of dietary energy available for retention as body weight. The CapTri® diet helps you lose fat because more of your dietary calories are lost as heat, causing your body to draw on fat stores as fuel. Cutting calories also causes your body to draw on it's fat stores for fuel, but this approach leads to muscle loss and slows down your metabolic rate, which slows down fat loss. CapTri® shifts your metabolism into a fat-burning mode without cutting calories and slowing your metabolism. Many bodybuilders go on CapTri® to lose body fat and are surprised to find they actually gain muscle at the same time. The last important reason why CapTri® helps you lose fat is that by substituting CapTri® for carbs you decrease insulin levels. Insulin is released in response to carbohydrate feeding and blocks the breakdown of body fat. With CapTri® you can decrease carbs to lower insulin levels and promote the use of body fat as fuel without sacrificing your energy level and lowering your metabolic rate. You can learn more about regulating the Glucagon-Insulin ratio by consulting the Parrillo Sports Nutrition Guide.

In the next bulletin, we'll talk more about the benefits of supplements in your nutrition program.

References

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