TEAM GARNER

PROTEIN INTAKE STRUCTURE AND FUNCTION

ULTIMATE NUTRITION MENTORSHIP

PROTEIN STRUCTURE

Everybody is familiar with protein, what most people don't know is that protein is actually made up from 22 different amino acids. Put another way, it takes 22 different amino acids structures to make up what we refer to as protein.

Although protein contains 22 amino acids, only 9 of the 22 amino acids are considered essential. What makes these amino acids essential is that our body needs them for survival and unfortunately has no way to manufacture them. Whereas the other 13 amino acids, although still required for survival, can be created in the liver through transamination (as discussed in the digestion and absorption document).

This is what differentiates a complete protein source from an incomplete source. Complete proteins contain all 9 essential amino acids (EAA's) whereas incomplete sources lack significant amounts of either one or more EAA's. Typically, most animal foods are considered complete sources and the incomplete sources can be found within grains and vegetables.

AMINO ACIDS		FOOD EXAMPLES	
ESSENTIAL	**NON-ESSENTIAL**	**COMPLETE**	**INCOMPLETE**
Histidine	Alanine	Meat	Nuts
Leucine	Glutamic acid	Fish	Seeds
Isoleucine	Aspartic acid	Milk	Vegetables
Lysine	Glycine	Whey	Legumes
Methionine	Serine	Eggs	Grains
Phenylalanine	Proline	Quinoa	Hummus
Threonine	Glutamine	Casein	Potatoes
Tryptophan	Asparagine		
Valine	Cysteine		
	Tyrosine		
	Arginine		

Although this topic sounds pretty cut and dry, it's a little messier than I've made it sound. In some cases, a handful of the non-essential amino acids can become what is known as *"conditionally essential"*. In that, under certain extreme circumstances the body can require a high amount of a non-essential amino acid and therefore begin to start depleting its own stores at a faster rate than it can create them. Thus, making a non-essential amino acid *"conditionally essential"*. For example, glutamine is not considered an essential amino acid for everyday living, but in circumstances such as post-surgery, high stress, physical/mental trauma, or serious burn damage; the body can need glutamine at a quicker rate than it can produce.

To add to the mess, most of what is considered an incomplete source of protein is actually technically a complete source with only a few exceptions (such as collagen). I chose my words carefully above in saying that incomplete sources are simply sources that have low levels of the essential amino acids, they are in almost all cases not completely devoid of them.

In the case of veganism or vegetarianism, it then becomes very wise to familiarize yourself with the amino acid profiles of your allowed foods and begin creating complementary meals of the incomplete protein sources to balance each other out to then create a combined complete protein source. Put another way, if one plant protein source has excellent levels of amino acids XYZ, but low levels of amino acids ABC, then it would be wise to combine it with another plant protein source in the same meal that had low levels of amino acids XYZ, but high levels of ABC.

Some combination options in this scenario to create complete protein sources out of plant-based options would include:

- Rice and beans
- Spinach and almonds
- Hummus and pitas
- Whole grain noodles with peanut sauce

Funny how tradition actually brought these on?

Biofeedback at it's finest.

It should be noted that these don't necessarily have to be eaten together to be considered intelligent complimentary amino acid profiling. So long as you get these servings in throughout the day, the body still has access to the amino acids and will be better off for it. In either case, you're creating a more well-rounded amino acid intake when you're looking at the entire day. This will lead to greater overall health and accelerated results within the gym and your health.

PROTEIN FUNCTION

The importance of protein in nutrition and health cannot be overemphasized. It is quite appropriate that the Greek word chosen as a name for this nutrient is Proteos, meaning *"primary"* or *"taking first place"*. Proteins are found throughout the body, with over 40% of body protein found in skeletal muscle, over 25% found in body organs, and the rest found mostly in the skin and blood. The typical person on the street will tell you their muscles are made up of protein, which is correct, but both your cardiac and smooth muscle tissues (surrounding blood vessels, lungs, intestines, etc) are made of protein as well and require it for proper function. Skin and hair both contain a high percentage of protein as well.

When it comes to body composition, protein takes the front seat being the most important macronutrient of them all for several reasons:

1. Your muscle is literally made out of it

2. It signals to body to build muscle mass

3. It prevents your current muscle mass from being lost

Protein is absolutely essential for survival, we cannot live without it. Proteins participate in structural capacities, enzyme creation, hormone creation, transporters for all nutrients, immune function, among many other things. When people think protein they typically only think of body structure, but many hormones are simply just links of long amino acid chains (insulin being a very familiar hormone that is simply amino acid chains). Proteins also contain amino acids which act as precursors for hormonal and neurotransmitter creation. For example, tyrosine is the main ingredient for things such as adrenaline, nor-adrenaline, and dopamine.

Protein can also be utilized for energy given the correct context, this mainly happens in two different ways:

1. With the overconsumption of protein due to either poor meal tracking or terrible recommendations being made by self-proclaimed experts

2. During a low carb diet

One thing that needs to be made clear right here, ***more protein does not equal more muscle.***

After the cells of the body are filled with stored protein, any additional amino acids can be degraded and used for energy or stored as fat or glycogen. In other words, once you have hit your required/recommended intake for protein there is no further benefit to going above and beyond what's ideal. It will act like any other macronutrient and be subject to energy use or to be stored as glycogen or fat. Protein is not this special nutrient that can't be stored as fat. This isn't to say high protein is damaging to your body (unless you have pre-existing kidney issues that is), but I am saying more is not better or even beneficial when compared to what else you could be eating.

The degradation of proteins occurs though a process called deamination, which as we discussed in the previous digestion and absorption section is the removal of the amino group from the amino acid. This process almost exclusively occurs in the liver. The resulting keto acids can enter the Krebs cycle for further metabolism. The conversion of amino acids to keto acids is called ketogenesis. (Examples of keto acids are: pyruvic acid, acetoacetic acid and levulinic acid).

The conversion of amino acids into glucose or glycogen is called gluconeogenesis. 18 of the 22 amino acids have structures that allow them to be converted to glucose and 19 of the 22 amino acids can be converted to fatty acids. Although the process to convert protein to glucose or fat is more energy costly to the body, it doesn't mean it's not there and that the body won't use it. In fact, the conversion of protein to glucose is so effective that eating a high protein diet can completely prevent you from entering ketosis. The literature has shown that 100g of protein can be converted into 57g of glucose, that's really effective and depending on how much you're eating can stop you in directly your keto tracks.

From an energy production perspective, the body almost entirely uses carbohydrates and fats for energy. But for the people out there increasing protein intake well beyond levels required to support bodily functions + gains in lean muscle mass, additional protein will not do you any good. It could also in fact be detrimental due to the fact that if you're eating more protein, odds are you are eating less carbohydrates and/or fat which would be doing a much better job at supporting your energy and health needs.

Additionally, high protein intakes have been correlated to both lowering your testosterone secretion and increasing your SHBG (we'll talk more about this in a couple weeks). It's a proverbial one-two punch against your anabolic hormone production. Testosterone is something we definitely want within the healthy ranges if making maximal progress in the shortest amount of time is something we want to do. Moreover, testosterone levels are associated with many health outcomes as well such as cognitive decline and heart disease risk, so regardless of your goals this is something important to care about. When a closer look is made, it seems as if the correlation is tied more so to the ratio of protein to carbohydrates in the diet (Within the same vein but for a preview into fats, diets high in polyunsaturated fatty acids but low in saturated fatty acids lower anabolic hormone levels as well). So not only do we have no structural benefit of over consumption, but we also have some potential internal downfalls due to the greater absence of healthy fats and carbohydrates along with the negative implications on our endocrine system.

PROTEIN INTAKE

If there is one thing that nutrition experts have been debating since the dawn of nutritional support for the active population, it's protein intake. Although it should be noted first that within this protein intake section, we are going to discuss many variables regarding protein intake for the athletic population but we will not be talking about the particular timing strategies as those will be saved for a later date.

The pendulum has swung from high to low, to moderate, back to high again, and everything in between. You know, kind of like how we have been debating about everything else in nutrition since the 60's (it's no wonder why everybody is so confused all the time). Luckily for us, much of the debate is between super nerds fighting about a 0.2g/pound of body weight difference per day.

To put it short and offer somewhat of a spoiler alert, **WHO CARES?**

Debates can be seen online between these two groups and they are literally talking about a 1/2 chicken breast or 1/2 scoop of protein powder difference per day. Provided you're meeting the minimum intake, which we will discuss below, differences such as this are trivial. The differences only come into play when we are talking about extremes.

For example, the bodybuilding population insists they need a tremendous amount of protein per day to keep up with their demands, at the other extreme are dieticians claiming the Recommended Daily Intake (RDI) of protein for athletes is 54g per day across the board.

Two equally ridiculous scenarios.

However I don't want to paint the picture that I think people are bad for believing these recommendations. Magazines speak mostly to bodybuilders in their early years of training and the bodybuilders don't realize that a supplement company makes a tremendous profit by telling you that you need 2g of protein per pound of body weight (or 4.4g per kilo). As well the general public reading the governments RDI's just simply don't know any better. These two groups aren't bad, they are just slightly misinformed based on what data we have in modern sports nutrition.

It's important we first clarify that percentages in reference to intake is not helpful to us at all. For example, the Institute of Medicine has suggested 10-35% of our daily calories come from protein.

Why isn't this helpful?

Well, that's a hell of a range to choose from first off, the high end actually being 3.5x more intake than the low end. Additionally, even if we went with 35% this would almost always lead us to eating too little protein within a caloric deficit, and too much protein within a caloric surplus. So to bring more accurate answers, it's wise to use the *"grams per pound of body weight"* method as this allows you to individualize the process further and not run into any wild swings up and down depending on your current goal.

For example, maintenance caloric intake for a 180lbs athlete (81.8kg) would be approximately 2700kcals. If this athlete were to simply eat 10% of their intake from protein, he would be consuming a measly 67g of protein per day which falls well under the recommended amount for optimal muscle gain and/or the prevention of muscle loss. Conversely, if he goes to the other end of the spectrum and consumes 35% of his intake from protein, he would be consuming 236g of protein per day. An amount that far exceeds would he would ever need in order to maximize his body composition and health goals.

Hundreds of studies have been done on protein intake and it's at a point now where the debate is no longer necessary in my opinion. Studies have been conducted on the general population, powerlifters, weightlifters, bodybuilders, recreational lifters, gymnasts, boxers, etc. You name it, there is probably a protein study on it. Being that we have hundreds of these studies done and now even have studies done within a metabolic ward where every last detail is tightly controlled, we have a much better understanding of protein intake and can begin to narrow down the range.

Where it stands right now, the optimal range for athletes is within the 0.8-1g per pound of body weight mark.

I want to point out that this is per pound of body weight on the scale, and not fat free mass. Some calculators out there like to utilize fat free mass to determine protein intake, but many of the methodsf which examine fat free mass have high error rates. Bioelectrical impedance scales and inexperienced caliper measurements are probably the worst of the bunch.

Using that range, it is highly recommended that you utilize the low end of the range (0.8g) for those with a higher percentage body fat and utilize the high range (1g) for those with a lower percentage body fat. A 200lbs guy at 5% body fat is going to require a greater protein intake (due to muscle mass content) than a 200lbs guy at 40% body fat. On this note, this range is applicable for both mass phases and lean down phases, there is no reason to go outside of these numbers, especially if you choose the 1g per pound of body weight figure which is enough to suffice all of your needs plus even with a safety margin of *"making sure it's not too low"*. 1g per pound already offers you that safety net.

Turns out some old-school bodybuilding know-how had some great intuition since a large majority of them have been recommending 1g per pound of body weight for decades (with a smaller sub-population recommending the gigantic numbers). Sticking within our ranges, this means the average 180lbs guy would be consuming 144-180g of protein per day as a daily total. When you start escaping these ranges either on the high end or the low end, you're also likely escaping the best results you could possibly get.

This can be good news and bad news at the same time for some people.

Bad news being that your trainer or social media guru has lied to you and you have been eating too much protein this entire time (and possibly clearing rooms with your gas), but the good news being that protein is the most expensive macronutrient to buy so now even though your protein intake is going down, your wallet will most likely gain some much-needed mass. Within this spectrum, your clients will also appreciate not paying for 1.5-2g

(3.3-4.4g) of protein per pound or kilo of bodyweight per day. Most of them complain healthy eating is already expensive enough.

Although theoretical, I feel motivated novice trainees or reformed meatheads making a comeback with lots of muscle memory have a logical reason to consume slightly higher than the above mentioned recommendations. Conversely, very advanced trainees have logical reasoning to stay on the lower end of the spectrum. I know that sounds completely backwards as most advanced trainees feel they need more protein and most novice trainees aren't at *"that level"* yet, but the reasoning is there from a physiological perspective.

This reasoning simply lies within rate of muscle growth potential.

Novice trainees, or people coming back from a layoff who used to be jacked, can both gain muscle mass at incredible rates if they are in the right mindset. The typical 0.8-1g per pound of bodyweight may not suffice the supply and demand that these specific populations require. Although this isn't a right to go nuts, ranges of 1.1-1.5g per pound of body weight can make a lot of sense here.

Now on the other side, advanced trainees nearing their genetic potential build muscle at incredibly slow rates. Due to a reduced muscle protein synthesis (since they aren't building muscle at the same rates as novice trainees), this can ultimately lower their total daily need for protein, and make room for other nutrients such as carbohydrates to more effectively fuel their workouts and allow them to train harder and longer. It seems advantageous to supply an advanced trainee with more fuel to train hard and recover effectively since they have to much higher standard now of workout intensity to meet in order to continue making progress.

However, I want to say that research doesn't exist in this area of lowering protein intake in advance trainees, so I generally don't recommend ever going below the standard guidelines, but it's a place in which I feel future research will guide us towards and an area of experimentation I feel would yield positive results.

For those of you interested in the world of performance enhancing drugs and/or anabolic steroids and have heard that steroid use requires you to increase your protein intake dramatically from my original recommendations, I wouldn't tend to agree with this type of ideology.

It is very common to hear of astronomical protein numbers coming from bodybuilding and other strength athletes taking anabolic steroids, but the reality of the matter is that they both increase and decrease your needs for additional protein in the diet. They increase your daily protein needs through an increased training intensity and an increase in protein synthesis rates, but at the same time they decrease your daily protein needs for protein through enhancing your body's protein efficiency, decreasing your rate of muscle loss, and enhance protein metabolism. At the end of the day, these two factors cancel each other out and what you're left with is the old fashioned 1g per pound of body weight per day. So although you will create greater protein synthesis rates with anabolic steroids, the improved protein digestive efficiency they provide in combination with the fact that they reduce protein breakdown makes the trade-off equal in the end.

Lastly on the daily totals, I think it is important to note that the body can actually manufacture up to 70g of its own protein per day, but this figure is not included within the recommendations and you are still required to consume 0.8-1g per pound of body weight per day. This 70g mark comes from estimations that your body consumes 50g of proteins from the mucus within the G.I. tract and up to 20g through glycoproteins each and every day.

"CAN YOU ONLY ABSORB 20G OF PROTEIN PER MEAL?"

Absolutely not, while it is true that protein synthesis from a meal has a ceiling you can hit, further prevention of protein breakdown efforts can be made with higher intakes during a given meal. Less protein breakdown is just as important as more protein synthesis. One is not more important than the other and regardless of the amount of protein you take in during a meal, your body will still be utilizing it.

20-30g are typically the magical numbers being thrown around, this was largely born out of discovering the *"leucine threshold"* which we will discuss in its own section below. These numbers are incorrect on a variety of levels for what we can absorb in a meal, but starting first with digestion. The digestive process is not that weak and is incredibly efficient at absorbing everything we take in. To put it short, if you take in less protein, gastric emptying will be quicker because the actual digestive process isn't as intensive.

Conversely, if you take in a very large meal gastric emptying will take much longer as breaking down the entire meal and assimilating it into the system takes much more work. Larger intakes still get utilized to their fullest, it just takes the digestive system longer to do it.

Secondly, 20-30g being the *"maximal amount the body can use"* could never apply across all populations regardless of body size, habitual intake, and activity levels. It just doesn't make any sense. Let's also consider our ancestors, we would be a long extinct species if caveman had to eat 6 meals per day at 30g protein per serving.

How about some of my NFL clients who are linemen slightly below or slightly above 300lbs?

6 meals per day at a maximum 30g protein per meal would only yield them 180g protein per day, far under what they should be eating.

Spread the word on this one, this myth has got to die sooner or later.

PROTEIN QUALITY AND SOURCES

As far as sources go, people typically divide them into two different categories:

1. Whole foods
2. Supplements

Whole foods of course representing whole food sources such as fish, chicken, steak and cottage cheese. Whereas supplement sources representing whey, casein, plant powders and soy protein.

As I'm sure you know, not all proteins metabolize at similar speeds and as discussed above, the total content of the meal can change speed as well (For example, a 16oz Ribeye will take longer to breakdown and metabolize than a 4oz Ribeye. This provides the body with amino acids for a longer duration, and the thought is also making me hungry). To complicate things further, some proteins are better used by the body than others as well. For example, animal proteins typically have a 90-95% efficiency whereas vegetable protein sources fall slightly below that at 80-85% efficiency.

To determine the quality of proteins, many different ratings and scales have been created in the past, such as:

Chemical score: Chemical score is a method in which the rating of proteins is done through measuring its EAA content and comparing it to another reference protein. You can compare this process to the glycemic index in a way in that the glycemic index has a reference for pure glucose at 100 and all other foods are measured based in reference to that. Eggs have been used as the premier reference protein in the case of chemical scores. Although

chemical score can be somewhat useful, it has drawbacks including the assumption that egg protein is #1 and that digestibility is not taken into consideration.

Biological value: The biological value of a protein is determined by the amount of nitrogen retained in the body divided by the amount of nitrogen absorbed from that protein.

BV = (nitrogen retained / nitrogen absorbed) x 100

Therefore, a biological value of 100 would indicate complete use of the protein ingested in that none of the protein absorbed was lost. Although biological value is one of the more common approaches used to measure protein quality, it has its drawbacks as well. A few being:

1. Nitrogen balance is far from a perfect test (thorough details on this aren't necessary to know)

2. Biological value gives you a look at what the whole body is doing, as opposed to a specific tissue. For example, you could be promoting greater protein synthesis within an organ such as the liver instead of your muscle mass, but this would go undetected.

3. As protein intakes go up, biological value goes down. Without perfect control of test subjects, this can make things messy. For example, dairy proteins have been shown to have a perfect 100 biological value at low overall protein intakes, but this can drop to 70 with adequate intakes. Think about it like pouring water into a glass that's already full.

Net protein utilization: Net protein utilization is an almost identical method to biological value, with the exception that both measure nitrogen retention within the body but net protein utilization measures the amount of nitrogen retained in the body to the amount ingested whereas biological value measures the retained amount that is actually absorbed from the gut. Basically, net protein utilization is biological value but with the missing link of correcting for digestion, which gives biological value the slight edge in applicability.

Protein efficiency ratio: The protein efficiency ratio is a method that measures the actual weight gained in grams after the consumption of protein. For example, a score of 2 would mean that 2g of total weight was gained for every gram of protein ingested. In the efficiency world, a score of 2.7 is considered a high quality protein. It lacks applicability in the real world though due to the fact that measuring a human's weight in grams in nearly impossible, so the research has been conducted on small animals taking in very small amounts of

protein. One interesting note however was a study done using protein efficiency ratios in animals and found that the greatest scores came from the combination of animal and plant sources of protein in comparison to either one in isolation.

Protein digestibility corrected amino acid score (PDCAAS): PDCAAS is a method of evaluating the protein quality based on both the amino acid requirements of humans and their ability to digest it. Similar to chemical score, the PDCAAS uses a reference protein based on an amino acid profile they deemed most suitable for humans. PDCAAS is considered to be the gold standard in protein quality rankings due to its reference ranking and the inclusion of digestibility. Although problems still do arise due to the fact that the ideal amino acid profile for any given athlete can change based on the context. In addition, the PDCAAS scale sets the highest possible score at 1.00 and any values scoring above that are being rounded back down to one. This opens up the thoughts of a possible misrepresentation of the size of the gap between the higher quality and lower quality scores.

While I could continue to talk your ear off about all the different quality rankings, different studies they appear in, what happened in the studies, and create a big table comparing all the data; I would be wasting both my time and yours.

Although all these methods of protein quality measurement give us pieces of information, none of them are really great for human use at the end of the day. They are all theoretically based and each bring their own disadvantages to the table. You don't really care how much a rodent grows, some of them have no amino acid requirements, none of them give us tissue specific protein synthesis, and many of them lack any digestibility score. Keeping in mind also, none of these quality rankings were created for sports nutrition in the first place. So the next time a trainer, guru, or supplement ad brings up this type of data, you're going to be much better armed for battle.

What I can tell you though is that it can be made simple. Your best choices are meat, dairy products, and eggs. I want to make note that when I say meat, I don't just mean red meat. I am referring to all chicken, fish, red meat, wild game, pork, buffalo, etc. In second place are plant sources such as legumes, nuts, and high protein vegetables like peas, broccoli, and spinach.

Although it's wise to get a premium source of protein at each meal, research has demonstrated that it really doesn't matter much ***so long as you're getting an adequate intake in per day.*** Meaning, if you're getting in 1g per pound of bodyweight of protein per day, the sources in where you get that protein from become less and less important the more and more of it you eat. There is a very low probability that you will be lacking any amino acids at that kind of intake, that is unless your diet is really messed up.

Where protein quality sources matter the most is in diets where protein is **inadequate,** such as in suffering and/or starving countries. Giving them a high quality protein source does fantastic things for their health, but for the 200lbs athlete already eating 200g of protein per day, not so much of a big deal.

Choosing lean meats is ideal in most cases as fattier meats can add up in caloric intake very quickly and become very hard to program into a diet without some substantial subtraction from another area. This is normally not an issue in a hypercaloric state, but can be during a hypocaloric state or in maintenance. For example, an 8oz filet mignon is just under 600 calories, whereas an 8oz chicken breast is 368 calories and packs more protein in it as well. It's much easier to program in a hypocaloric so that one meal won't take up a 1/3rd of somebody's daily intake.

Moving on to supplemental sources, these are powdered or liquid foods that contain protein from various sources including whey, casein, egg, soy, and other various plant-based options such as brown rice, hemp, or peas. While supplementation isn't necessary for health and fitness, it can make things easier with practicality, ease of transport, convenience, low cost per serving, and in some cases provide their own unique benefits.

WHEY

Whey is a semi-clear residue that is a liquid by-product of cheese production. After cheese curdles up, the filmy weird substance leftover is what we are slamming back post-workout. Back in the old days it was just thrown away as a waste product of cheese production, but thankfully scientists found out it is a complete protein source that we can use for both health and body composition change.

Without a doubt it is the most popular protein product on the market today. It doesn't taste bad, it's cheap, the amino acid profile is very impressive, and whey contains the richest source of BCAA's in existence. You can take it anytime, although it's particularly effective post-workout due to its rapid metabolization which causes a more dramatic spike in amino acids in the blood which in turn, stimulates muscle protein synthesis very quickly and effectively compared to other sources.

You will see it come in many forms which is typically defined by how ***much*** processing has been done and what ***type*** of processing has been done to the original product. Concentrates are further processed into isolates, isolates can then be further processed into hydrolysates.

Isolates are the best option of the bunch, as research has shown hydrolysates absorb no faster (which was the original gimmick) than isolates and isolates are also typically lower in unnecessary fats and cholesterol compared to concentrates, while being cheaper than it's non-superior more expensive counterpart in hydrolysates.

Although the fast absorption of whey is typically seen as a benefit, there are two edges to the sword here. This same fast absorption that causes a quick rise in blood amino acid content and muscle protein synthesis, has a minimal effect of preventing protein breakdown and can also result in greater oxidation (burning off) of amino acids due to the body not wanting those high levels in the bloodstream. Speedy in (high muscle protein synthesis), speedy out (won't stick around to prevent protein breakdown rates).

This quick amino acid excess can exceed our body's limit of use for them which can then push them towards oxidation, resulting in an anabolic effect but a very small anti-catabolic effect. Although it's important to note that if you add fats and fiber to the whey-contained meal it will slow the absorption of the amino acids into the bloodstream and make it act more like a *"slow"* protein. Additionally, these extra fats and fibers will help decrease protein breakdown; solving the double-edged sword issue entirely.

CASEIN

Casein is probably second place in popularity behind whey, and is also a protein found within milk. The curds that form as milk coagulates, such as the chunks in cottage cheese, are casein.

Upon digestion casein actually forms a clot in the stomach, drastically slowing digestion. Amino acids don't increase at the quick rate like they do with whey protein consumption, instead this clotting in the stomach creates a slow and sustained release of amino acids for up to 8hrs. Because of this, casein tends to have a smaller effect on anabolism and a greater effect on anti-catabolism.

There's ongoing debate between specialists about whether athletes should be supplementing with whey or casein, but here are some key points we can agree on:

1. Due to whey's rapid digestion and leucine content, it's probably the best choice for post-workout protein

2. Due to the slow release of amino acids from casein, this makes for a great pre-bedtime protein option to prevent protein breakdown rates while you sleep. For the same reasons, it's great to use throughout the day as an overall *"general use"* option

3. Choosing one doesn't have to be your only option, a 50/50 split between the two can be effective in all scenarios to get the best of both worlds (anabolism + anti catabolism). I do this very often with my clientele, it's the most logical approach provided somebody doesn't have a sensitivity to either nutrient

4. Casein is probably a good protein to have around in a hypocaloric state to prevent protein breakdown for as much of the 24hrs as you possibly can

5. Although both whey and casein have very good BCAA content and provide calcium, whey is able to elevate antioxidant status to a greater degree due to the high cysteine content of whey which can serve as a way to raise a very powerful antioxidant known as glutathione

EGG PROTEIN

To this day most general population and athletes don't even know that you can buy egg protein powders. There are available in two main forms, whole egg protein powder and egg white protein powder, main difference between the two being that whole egg powder contains the fat and cholesterol of the yolk still. It's important to note that this brings down the protein per serving quite a bit for the whole egg protein powder having to include the fat in every scoop as well.

From an amino acid profile perspective, egg white protein is nothing special in comparison to whole egg powder which edges it out slightly in protein quality rankings.

The biggest draw towards egg protein powders is for convenience and for the athletes whose digestive system doesn't do well with the available dairy options (whey + casein). I say convenience number one and not price mainly due to eggs being incredibly cheap in the first place. We have people from all over the world in this mentorship, but, I know here in Canada I can get a dozen of good eggs for about $3.00 every time, more if I go to Costco and get the crates.

Other benefits of egg protein include a perfect 1.0 score on PDCAAS, effective stimulator of protein synthesis, and a very slow amino acid release similar to that of casein. Overall, underrated and under talked about option, but also nothing to run to if you don't have a sensitivity to whey or casein.

SOY PROTEIN

Soy protein is a really messy, mixed bag.

Research has undoubtedly demonstrated soy proteins ability to quickly and effectively stimulate protein synthesis, although the controversy continues due to its feminizing effects in males. Soy protein contains isoflavones which are estrogen like molecules that can disrupt endocrine homeostasis.

A study out of Harvard analyzed the semen of 99 men and compared it against their soy and isoflavone intake during the previous three months. What they found was that both soy and isoflavone were associated with a reduction in sperm count. The men who had consumed the most soy during this time frame had an average 41 million less sperm per milliliter than men who did not consume soy. Although within this same category, research at the University of Guelph had 32 men eat low or high levels of isoflavones from soy for 57 days and found no effect on semen quality. Furthermore, two separate literature reviews have concluded that neither soy or isoflavones effect hormone levels.

In terms of antioxidant status, two studies have shown 40g of soy protein per day improved antioxidant status to a greater degree than whey when combined with exercise. Although when it comes to lean body mass and body fat changes, milk proteins tend to be the superior option. This difference in body composition is thought to be from soy protein's preferential metabolization in the gut and liver whereas dairy proteins provide more amino acids ultimately being delivered to the muscle cell.

So what's the simple answer here?

Well, like all things in nutrition when we are looking at it through a magnifying glass, there really isn't a simple answer.

Main reason being that soy's effects on the body can vary depending on your intestinal bacteria. These bacteria which are present in 30-50% of people, will metabolize a particular above mentioned isoflavone called daidzein into an estrogen hormone called equol. This got really interesting when a study in 2011 at Peking University found that when men with the equol producing bacteria ate high amounts of soy for three days, their testosterone dropped while their estrogen rose. Making things more confusing, a study done on women found that in a high estrogen environment, isoflavones suppressed estrogen production, but in a low estrogen environment they increased estrogen production.

Research on soy's protective effects against cancer and heart disease are inconclusive to say the least, having papers demonstrating both sides of the coin. Also unless you have the qualifications, I would steer clear about discussing heart disease and cancer protection with your clientele.

At the end of the day, there are simply too many unknowns out there regarding soy protein for daily consumption. I don't really recommend its use for these reasons, especially so since there are so many other options available without this wishy-washy track record.

PLANT-BASED PROTEIN POWDERS

While soy is technically a plant based protein powder, it's not one that normally comes to mind when one brings up this category. Also, due to its large amount of mixed evidence I felt it was worthy of a section all by itself. Here, we are going to go over the much more commonly referred to plant based protein powders such as hemp, rice, and pea.

With a pretty weak PDCAAS score of 0.47, rice protein doesn't get us very excited. Although when we create a blend of rice and pea protein such as many products do, we create a far superior product as pea protein is ranked at 0.69 and also contains a high amount of leucine. You can refer to this blend as the *"vegan's whey"* because you're creating a similar overall profile and making the best of the situation you're dealt.

Hemp protein, although micronutrient dense (containing fiber and omega-3's), is only about 30-50% protein by weight, and of the minimal protein it does contain it isn't nearly as digestible as rice or pea protein sources. As far as digestibility goes, animal protein beats them all, but hemp is the lowest of the low.

Overall, pea protein edges the others out in isolation but I always recommend combining both pea and rice protein to get the best of both worlds. Although it's worth mentioning that most products on the market in this department are not as well flavored as their dairy counterparts and don't seem to mix as easily either.

To conclude and summarize supplemental protein quality and sources, I feel athletes should rely on whole foods for almost all of their protein intake. Although it's clear that protein powders can offer a variety of unique benefits in terms of price, convenience, micronutrient boost, macronutrient control, and pre/intra/post workout nutrition. These powders are typically available as concentrates, isolates and hydrolysates; with the price increasing in that same order. The so-called benefit of hydrolysates is that they digest quicker although research has definitely debunked that statement, leading to the fairly safe conclusion that

isolates are your best bet for pre/intra/post workout nutrition, and concentrates (or) casein options are better used outside of the workout window.

If I had to create a hierarchy, it would look a little something like this (keep in mind, context can change these recommendations):

Best: Eat whole foods throughout the day to receive the majority of your intake, and opt for dairy-based protein powders. Whey isolate for intra and post-workout needs, and casein for throughout the day and pre-bed use (if needed)

Better: Follow the food guidelines above, but utilize egg protein powder for your protein convenience needs.

Good: Follow the food guidelines above, but utilize a blend of rice and pea protein powder for your protein convenience needs.

Neutral/Potentially Negative: Follow the food guidelines above, and utilize soy or hemp protein powder for your protein convenience needs.

LEUCINE THRESHOLD

Leucine is an amino acid found in protein that is very well known as the king muscle building amino acid. It gets this reputation through research demonstrating that leucine even in isolation (not including any other amino acids from protein) stimulates protein synthesis, whereas other amino acids either don't do this at all or do it much less effectively. Leucine does this through stimulation of a pathway known as mTOR, which basically sets off an intracellular signalling cascade to tell the body *"let's grow some muscle"*.

What we know from research though is that there is something that is known as the *"leucine threshold"*, where in order to stimulate mTOR and protein synthesis you need to have a certain amount of leucine content within the meal and/or supplement that you're taking. Luckily for us, if you follow any of the recommendations I give throughout this course on protein intake and consume an animal protein source or well-designed complimentary protein combination at each meal, you will be able to cross this threshold relatively easily. In fact, adding leucine supplementation or BCAA supplementation to already protein rich meals has been shown useless both in the short term and long term research on a variety of levels including strength, muscle building, and fat loss. More is not better. Again, I'll refer back to the pouring water into an already full glass analogy.

As a minimum, the world leader on protein research Stu Phillips recommends you should be seeking 0.3g/kg of bodyweight of protein per meal, and that this meal contain a complete amino acid profile. As an example, the average 200lbs male would successfully be achieving leucine threshold content and stimulating protein synthesis with 27g of high quality protein. The only time in which I would perhaps recommend additional amino acid supplementation on top of a meal is if the meal contains poor, plant protein sources of protein with little to no effort towards creating a complimentary blend. To throw a target figure out for you that would be 100% safe and effective to elevate muscle protein synthesis, you're ideally looking for 3g leucine per meal.

LEUCINE CONTENT OF DIFFERENT DIETARY PROTEIN SOURCES			
SOURCE	**LEUCINE %**	**AMOUNT OF PROTEIN NEEDED TO REACH 3g**	**AMOUNT OF FOOD REQUIRED**
Whey isolate	12	25g	27g
Milk isolate	9.8	31g	34g
Casein	9.3	32g	48g
Egg	8.6	35g	4.5 large eggs
Fish	8.1	38g	158g
Beef	8.0	38g	126g
Pork	8.0	38g	133g

It should also be noted that the older populations (beginning at the age of 40+) likely require a greater amount of protein per meal in order to stimulate protein synthesis as effective as their younger counterparts. The resultant equation for the older population would need to reach 0.4g/kg of bodyweight.

MAIN TAKEAWAYS

- Protein contains 22 amino acids, although only 9 of those amino acids are considered essential
- Combining plant proteins to create *"complementary"* blend proteins is optimal for vegan and vegetarian clientele
- Protein plays vital roles to our survival through its necessity for tissue creation, enzyme creation, immune system homeostasis, hormonal transport and creation, neurotransmitter precursor activity, among many other important roles
- 0.8-1g per pound (or) 1.8-2.2g per kilo of body weight covers most everybody, most of the time unless there is a unique context that is client specific
- The body can handle as much protein as you throw at it, 20-30g max absorption per meal is a complete myth
- Animal meats and dairy products provide the greatest sources of protein and have the best track record on all protein quality scores
- More protein does not equal more muscle
- Preventing protein breakdown is just as important as supporting protein synthesis
- To meet leucine threshold requirements for protein in a given meal, it is recommended to the younger population to consume 0.3g per kilo of bodyweight per meal, and the older population to consume 0.4g per kilo of bodyweight per meal (this is assuming you are utilizing a high quality protein source)
- 3g of leucine per meal in most all cases will get the threshold job done

-Dan Garner

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