PROTEIN FOR HIGH PERFORMANCE SPORT PARTICIPATION

A Guide for Coaches & Athletes

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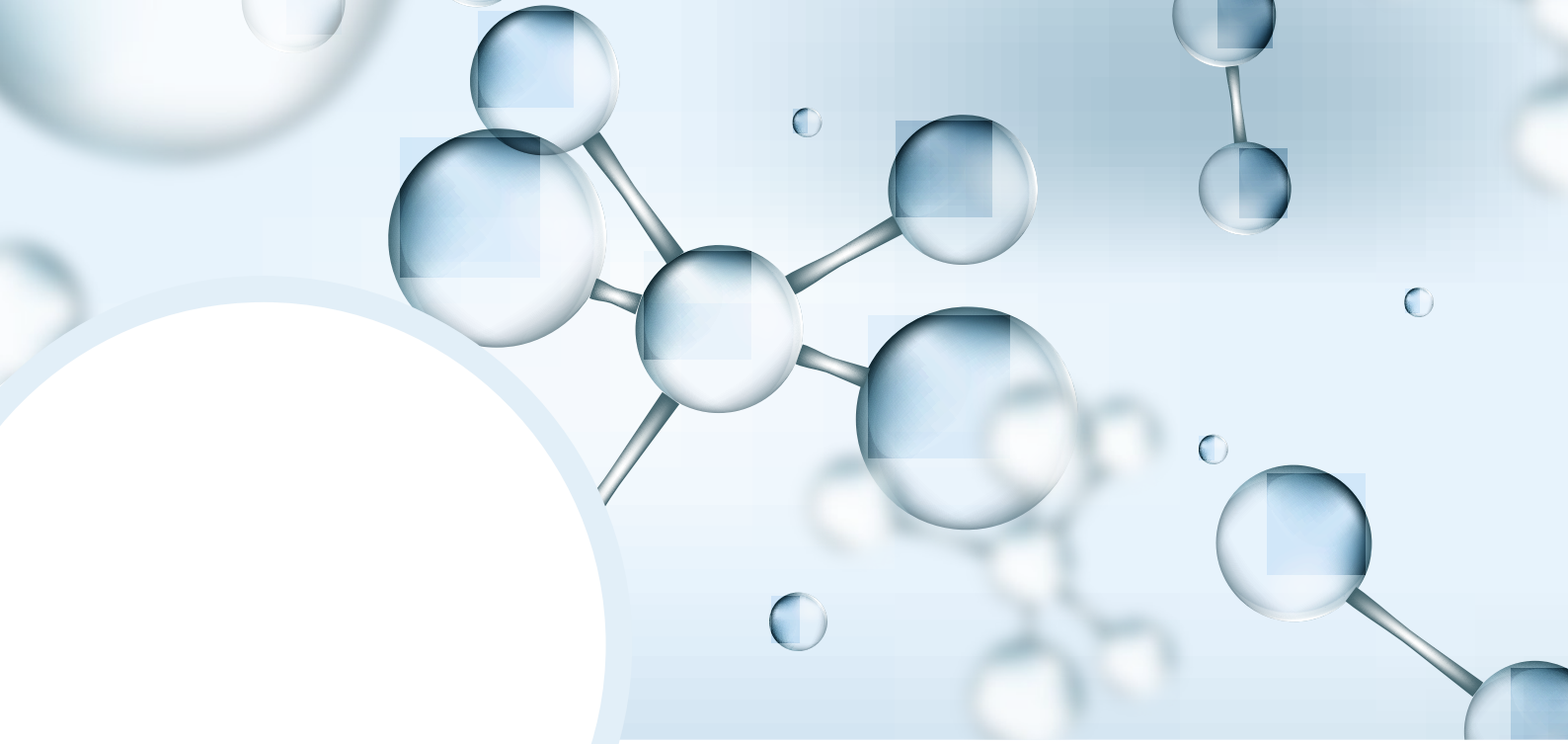


INTRODUCTION

Proteins are very important molecules to all forms of life. They are known as the building blocks of the body since one of their functions is repair. They make up to about 15% of your bodyweight and serves a variety of functions. Some proteins have antibodies, which help your immune system fights off infections, and hormones, which sends messages throughout your body. Proteins in the body are related to dietary protein that we consume from food. In fact, the body is made up of the same basic materials, and when you eat dietary protein, your body recycles these materials and make use of them to build all of the protein in your body.

Protein supplements are a popular supplement which is used by many athletes. They usually use them for different reasons: including to build muscle, lose weight or simply improve overall health and wellness.

Proteins are top on the list when it comes to essential nutrients, i.e. nutrients that the body cannot manufacture by itself. Proteins plays major role in the body. They are a source of energy, help repair damaged tissues, are essential for growth and prevents infections and disease. You will find proteins in abundance from foods like fish, meats, eggs, dairy products, grains, legumes and seeds. They are also available in protein powder supplements.

Amino Acids in the human body

There are 3 types of amino acids:

- All **essential amino acids** must be present for humans to form protein in the body. Essential amino acids cannot be produced by the body and must be consumed through the diet.
- **Non-essential amino acids** are produced by the body itself
- **Conditionally essentially amino acids** – these amino acids are considered essential under specific physiological conditions, i.e. under stress or immune depression.

Obtained from nutrition	Synthesized by the body
Essential amino acids	**Non-essential amino acids**
*Leucine (BCAA)	Alanine
*Isoleucine (BCAA)	Arginine (conditionally essential)
*Valine (BCAA)	Asparagine
Histidine	Aspartic Acid
Lysine	Cysteine (conditionally essential)
Methionine	Glutamate
Phenylalanine	Glutamine (conditionally essential)
Threonine	Glycine (conditionally essential)
Tryptophan	Proline (conditionally essential)
	Serine
	Tyrosine (conditionally essential)

Table 1: Essential vs Non-essential Amino Acids

From this table it is seen that 9 of the 20 amino acids are deemed as essential for normal functioning of the body. 6 of the 20 amino acids are deemed conditionally essential in certain circumstances, i.e. stress, illness, extreme exercise. Lastly only 5 amino acids are truly non-essential as it can be manufactured from other amino acids.
Certain amino acids are of *importance* for athletes. These are: Isoleucine + Leucine + Valine which together are known as **Branched Chain Amino Acids (BCAA).** Their functions are threefold for athletes:

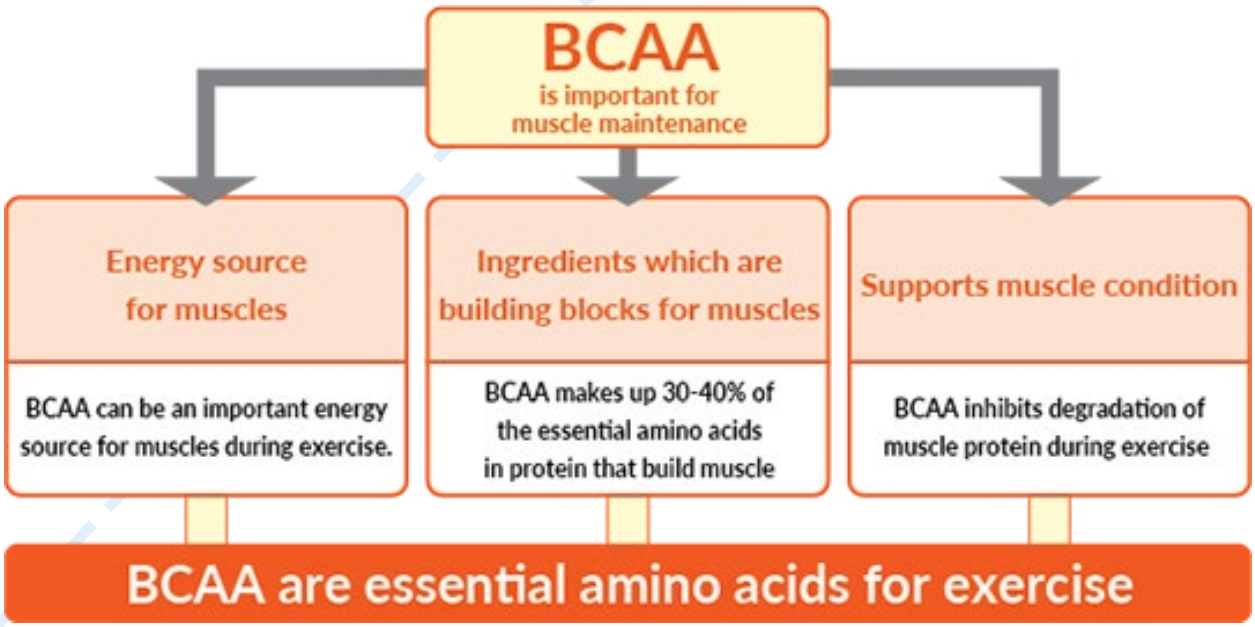


Figure 1: BCAA for exercise (www.otsuka.co.jp)

Another amino acid of importance for athletes is glutamine. Glutamine is an important fuel for certain cells of the immune system. Glutamine is also involved in promoting muscle glycogen synthesis and has recently been researched in its ability to improve muscular strength. Potassium- and magnesium aspartates are salts from the amino acid Aspartic acid. Recently it has been seen that these amino acids can enhance fatty acid metabolism and ultimately spare muscle glycogen utilization.
One of the more well-known amino acids in the athletic circles is Arginine. Arginine is a substrate for nitric oxide (NO) synthesis. It is a potent vasodilator which improves blood flow to enhance endurance, power output, lactate clearance. It is usually found in pre-workout supplements.

A complete protein is a protein that contain all the essential amino acids. Animal proteins such as dairy, poultry, eggs, beef and pork and soy as a type of plant protein are considered as complete proteins. Incomplete proteins are missing one or more essential amino acids. They are seen as lower quality proteins, i.e. vegetables, legumes, grains, beans, nuts & seeds.

The following foods are good sources of specific amino acids:

Amino Acid	Function	Food Sources
Histidine	Synthesis of histamine for immune system	Meat, poultry, eggs, fish, dairy, rice, green vegetables, bananas
Isoleucine (BCAA)	Heal or repair muscle tissue. Body recovery and energy for exercise	Soy products, meat, poultry, fish, dairy, eggs, legumes
Leucine (BCAA)	Tissue and muscle growth and repair. Encourages protein production in muscle	Soybean, hemp, beef, peanuts, pork, fish, almonds, poultry, eggs, oats
Valine (BCAA)	Muscle metabolism and tissue repair. Increases exercise endurance	Cheese, soybean, meat, poultry, nuts, seeds, fish, mushrooms, whole grains
Lysine	Essential for fat metabolism	Fish, dairy, eggs, meat, poultry, legumes, peas, lentils
Methionine	Natural anti-depressant and assists liver functioning	Nuts, beef, lamb, cheese, turkey, pork, fish, soy, eggs, dairy, legumes
Phenylalanine	Natural pain reliever. Production of adrenaline & nor-adrenaline	Dairy, meat, fish, poultry, eggs, legumes, nuts
Threonine	Assist in carbohydrate metabolism in mitochondria	Beef, pork, poultry, soy, liver, cheese, shellfish, nuts, seeds, legumes, lentils
Tryptophan	Natural sleeping aid	Chocolate, oats, dates, milk, yoghurt, cottage cheese, meat, poultry, eggs, fish, sesame, almonds, pumpkin seeds

Table 2 – Sources of specific amino acids

Most well-known protein types

- **Whey protein:** A **dairy-based** protein. It is **quickly absorbed** by the body, contains all essential amino acids
- **Casein protein:** A **dairy-based** protein. **Slowly absorbed** by the body which is why it's often consumed before bed, contains all essential amino acids
  - **Soy protein:** A **plant-based** protein that contains all essential amino acids. It is usually consumed by those that are lactose intolerant.
- **Pea protein:** A **plant-based protein**. It has low levels of essential amino acids cysteine and methionine.
- **Egg protein: Complete protein** (contains all essential amino acids). It contains a high biological value and **excellent digestibility**.
- **Rice protein:** A **plant-based protein** with low levels of the essential amino acid lysine
- **Hemp protein:** a **plant-based protein** made from hemp seeds that has high levels of fibre and omega-3 and omega-6 fatty acids. Hemp protein is low in the amino acid *lysine*.

A number of people use protein powders as a way to increase their protein intake if they are always on the go. Protein powders are convenient, portable and come in a variety of flavours.

Exceptions: Lactose intolerant athletes / people

Lactose is a form of sugar found in milk products. There are people whose bodies are not able to digest lactose and they therefore develop symptoms which include bloating, diarrhea, abdominal pain, nausea and vomiting. There are different levels of lactose intolerance and each individual is able to tolerate lactose to a certain degree. One person may be able to stomach few glasses of milk while the other cannot. The only treatment for lactose intolerance is to entirely avoid lactose by cutting foods which contain lactose out of your diet. Whey protein is the most famous form of protein *powder* which is a very high-quality protein source, it contains all the essential amino acids and is quickly absorbed by the body after you drink it. As whey is made from milk, it has a high lactose content, making it unsuitable for those who are lactose intolerant. The following are a few protein powders options appropriate for those with the sensitivity:

- **Whey protein Isolate**

Even though whey protein is made from milk, whey protein isolate is processed to such a high level that it contains small amounts of carbohydrates and is lower in lactose and that's makes it safe for people with lactose intolerance. It contains less than 1% lactose.

- **Soy Protein**
- **Pea protein**
- **Hemp Protein**
- **Brown rice protein**
- **Wheat protein isolate (high in glutamine, ideal for recovery)**
- **Egg protein**
- **Beef protein (soy free & high in BCAA; 30g serving provides 29.5g protein)**

Beef protein is a very new protein supplement on the market. The quality of protein is commonly debated among scientists, athletes and coaches. The two proteins that receive a lot of attention is the obvious whey protein, but now beef protein has received a lot of attention in aiding weight loss, fat loss, muscle growth and enhanced sport performance. Beef protein is cow sourced and until recently was consumed in the form of meat. Beef protein isolate is now available as a sport supplement. The exact production of the isolate is debatable as some claim it is made from cow flesh only, but others claim it is made from all the throwaway parts of the cow.

Protein Timing

There is a lot of confusion regarding the timing of protein intake. Protein intake is dependent upon many factors, but mainly the fitness and health goals, i.e. fat loss, muscle gain, strength gain, recovery etc. There are many times throughout the day that are ideal for protein consumption. In a nutshell, this means:

- That the most effective and efficient way for one to gain muscle and starve off hunger is to consume a fairly consistent amount of protein throughout the day.
- But what is the ideal intake of protein per day? Bodybuilders aim for 2g/kg body weight. Endurance athletes aim for 1.2-1.6 g/kg body weight. Athletes that want strength gains aim for 1.8g/kg body weight, but the majority of people will be able to function effectively with 1 g/kg body weight protein per day.
- Proteins can be consumed through natural foods or through protein shakes, depending on your schedule.

Protein is essential for life, it is crucial to all cells in the body playing a key role as enzymes in a cell. After water, protein is the most plentiful substance in the body.

Below are the best times to take protein based on your specific goals

Fat Loss

One of the most important nutrients for fat loss is protein. Consuming a diet high in protein can help increase your metabolism and reduce your appetite. By reducing levels of the hunger hormone *ghrelin*, while increasing levels of appetite-reducing hormones like *glucagon-like peptide-1*, protein helps curb your appetite. In simple terms, consuming a protein-rich snack between meals may lead you to eat fewer kJ later in the day. To obtain the most weight-loss benefits, aim to eat plenty of protein-rich foods throughout the day.

Best protein choices: Whey protein. Casein at night. Egg protein if lactose intolerant.

Building Muscle

Protein is important for building muscle mass.
For one to be able to build muscle and improve strength, you need to consume more protein than your body breaks down naturally during strength training. It is often advised to take a supplement 15-60 minutes after exercise. This period is known as the “anabolic window” and is supposed to be the perfect time for getting the most out of nutrients like protein. For the average person, the combination of strength training and consuming sufficient protein are more important than timing protein intake. With this being said, people training in a fasted state, like before breakfast, may benefit from taking protein shortly after a workout, as they haven’t consumed protein in a while. Another view to improve muscle mass is to consume protein 2 hours before strength training workouts. This activates protein synthesis in the body & gains from strength training will be seen.

Best protein choices: Whey protein. Beef Protein (including creatine). Casein protein at night.

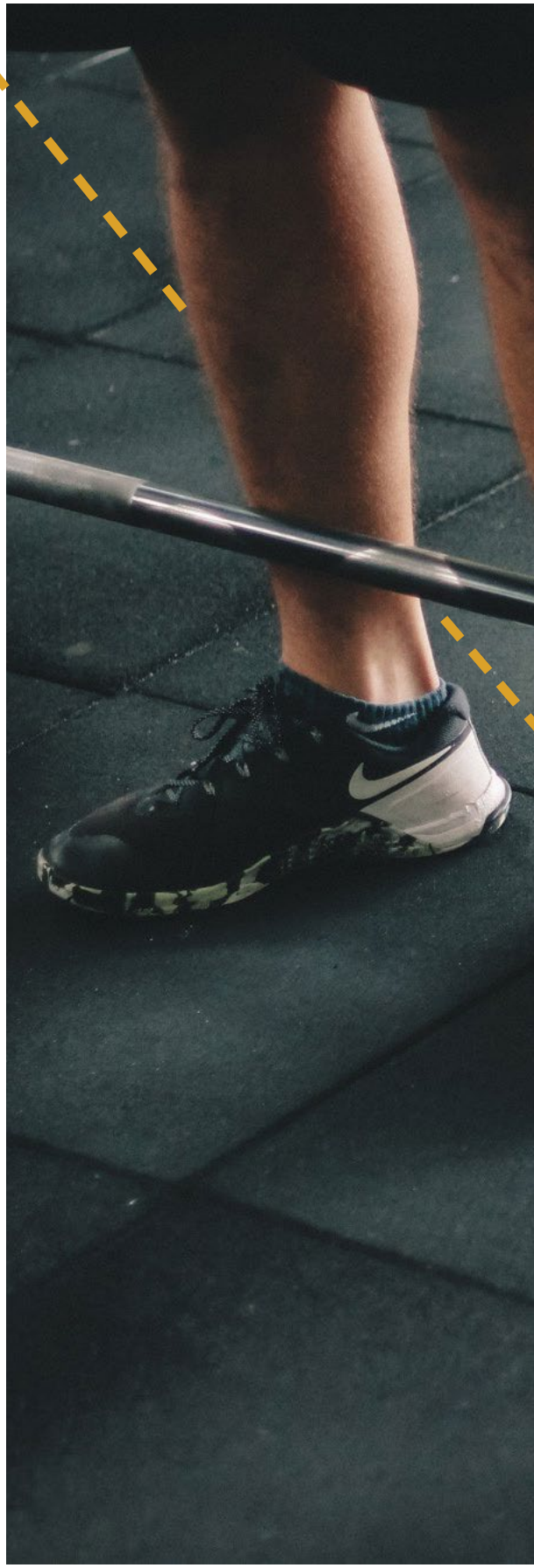
Preventing Muscle Degeneration

As you grow older, maintaining muscle mass is important. According to research, after age 30, people lose roughly 3% of their muscle each decade. Losing muscle is linked to a higher risk of fractures and shorter life span.

Scientists therefore recommend spreading protein intake evenly across the day to help prevent muscle loss with age. To combat muscle mass loss, one must consume roughly 25-30 grams of protein per meal.

Many people eat three times more protein at dinner than at breakfast. This makes consuming more protein at breakfast an ideal way to evenly distribute protein intake.

Best protein choices: Natural protein sources. Supplementation: Whey protein. Pea protein.



Exercise Performance and Recovery

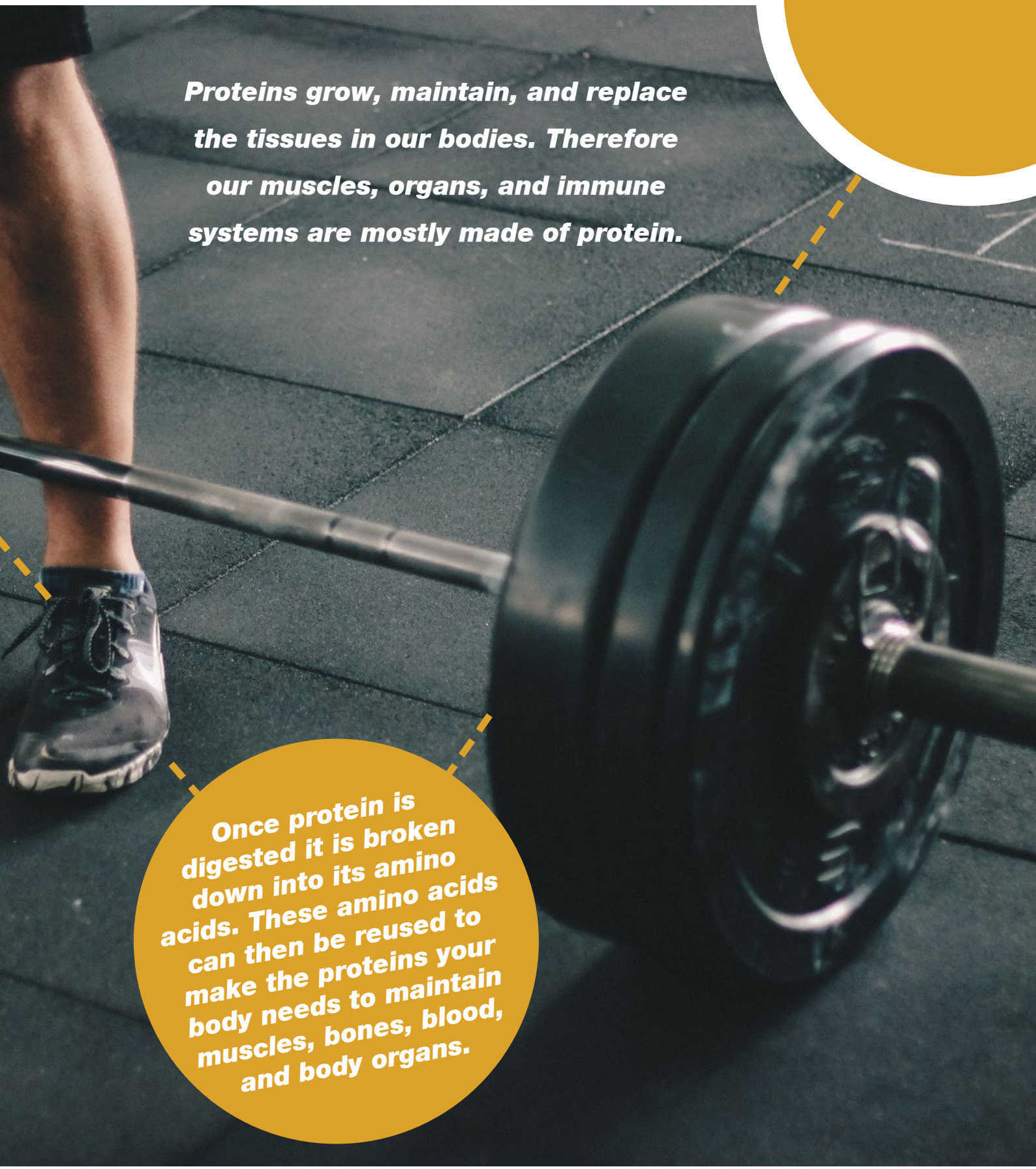
Athletes are often uncertain when should they consume protein for performance and recovery.

- Combining protein with a source of carbs after exercise may improve performance and recovery and reduce muscle soreness for endurance training.
- For strength training, protein can assist in improving both performance and recovery. Normally consuming adequate protein is more important than timing protein intake for most people, but athletes participating in strength training can benefit from taking protein either 2 hours before or immediately after a workout (anabolic window). Remember that taking protein too close to a workout will have a very limited effect on performance as most of the protein has not digested yet.

Best protein choices: Whey protein before / after a training session. Casein powder at night for recovery.

During a Workout

- Can use proteins during a workout, but selected amino acids (building blocks of proteins) which will benefit the type of training are advised
- Example: Branched Chain Amino Acids (BCAA), i.e. Leucine, Isoleucine & Valine are well known to provide good results when consumed directly before or during a training session. BCAAs are known for increasing energy and delaying fatigue.



Proteins grow, maintain, and replace the tissues in our bodies. Therefore our muscles, organs, and immune systems are mostly made of protein.

Once protein is digested it is broken down into its amino acids. These amino acids can then be reused to make the proteins your body needs to maintain muscles, bones, blood, and body organs.

What Is Whey Protein and where it comes from?

- Whey protein is a protein that's easier and quicker to be absorbed by the body than protein found in most food. With this being said, it doesn't mean that it is superior to food.
- As previously mentioned above, protein is required by the body to repair the muscle tears that occurred during strenuous and intense exercise. Muscle tears when one puts stress on them. Theoretically, by working out, you cause your muscles to breakdown. By replacing protein, you are aiding in building up muscle gain. This is how muscle growth takes place.
- An adequate amount of carbohydrates and fats are also required by the body to build muscle and strength.
- Whey protein has high levels of **leucine**, one of the three branched- amino acids making it ideal for muscle growth and repair.
- From cow's milk, whey undergoes a lengthy road to become the powder that fills each container
- Whey is pasteurized, to ensure that there are no harmful bacteria breeding in the milk
- Whey protein is manufactured from milk; it is an excellent source of protein for all age groups.
- 20% of the protein in milk is in the form of whey protein, while the remaining 80% is casein.
- Special enzymes are added to the milk to create the separation of curds and liquid whey.
- Whey is separated from the curds and then processed into whey protein concentrate, whey protein isolate or hydrolyzed whey protein.

Types of whey protein

Whey Protein Concentrate- produced through ultra-filtration and refers to whey protein which contains less than 90% concentration, the other 10% comes from lactose, minerals, and fats

CHOCOLATE

NUTRITION INFORMATION

Serving size: 27g Servings per pack: 37	Avg Quantity Per Serving	%DI* Per Serving	Avg Quantity Per 100g
Energy	401kJ	4.6%	1493kJ
Protein	21g	42%	78.2g
Fat, Total	1.6g	2.2%	6.1g
-Saturated	1.1g	4.6%	4.0g
Carbs, Total	1.9g	0.6%	7.0g
-Dietary Fibre	0.5g	1.4%	1.7g
-Sugars	1.4g	1.6%	5.27g
Sodium	36mg	1.6%	134mg
Gluten	-Nil detected		

AMINO ACID PROFILE

Essential Amino Acids	Avg Quantity Per 100g	Non Essential Amino Acids	Avg Quantity Per 100g
L-Leucine†	11.4g	L-Hystodine	2.0g
L-Isoleucine†	6.0g	L-Alanine	5.6g
L-Valine†	6.0g	L-Arginine	2.8g
L-Lysine	1.0g	L-Aspartic Acid	10.6g
L-Methionine	2.0g	L-Cystine	2.3g
L-Phenylalanine	3.8g	L-Glutamic Acid	18.3g
L-Threonine	6.9g	L-Glycine	2.0g
L-Tryptophan	2.0g	L-Proline	6.3g
		L-Serine	5.1g
		L-Tyrosine	3.3g

INGREDIENTS
Australian Whey Protein Concentrate, Natural Cacao Flavour, Stevia

Made in Australia from at least 96% Australian Ingredients.

* Percentage Daily Intakes are based on an average adult diet of 8700kj. Your daily intake may be higher or lower depending on your energy needs.
** All specified values are averages.
† Branched-chain amino acid (BCAA).

Contains Milk and Dairy Products.

Figure 2– Classic Example of Whey Protein & Ingredients (amino acid profile)

Whey Protein isolate- it is produced through a number of filtration techniques ensuring the removal of the majority of lactose and a greater quantity of protein (above 90%)

MIXES EASY | NO TASTE | NON GMO | GLUTEN FREE

Nutrition Facts

Serving Size: 2 scoops (30 g)
Servings per Container 15

Amount Per Serving

Calories 114 — Calories from Fat 3

% Daily Value*

Total Fat 0g **1%**
Saturated Fat 0g **1%**
Trans Fat 0g
Cholesterol 2mg **1%**
Sodium 43mg **2%**
Potassium 156mg **3%**
Total Carbohydrate 1g **0%**
Dietary Fiber 0g **0%**
Sugars 0g
Protein 27g **54%**

Vitamin A ..... **3%** Vitamin C **0%**
Calcium ..... **14%** Iron **1%**

*Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Typical Amino Acid Profile Per Serving

Alanine	1380mg	Lysine	2910mg
Arginine	630mg	Methionine	600mg
Aspartic Acid	2910mg	Phenylalanine	870mg
Cystine	780mg	Phosphorus	66mg
Glutamic Acid	5130mg	Proline	1650mg
Glycine	480mg	Serine	1110mg
Histadine	450mg	Threonine	1830mg
Isoleucine	1680mg	Tryptophan	480mg
Lactose	150mg	Tyrosine	810mg
Leucine	2910mg	Valine	1380mg

Ingredients: Whey Protein Isolate, <1% Lecithin (derived from non-GMO sunflower for mix ability)
Allergens: Milk

Figure 3– Example of Whey Protein Isolate & ingredients (amino acid profile)

Nutrition Facts

30 servings per container
Serving Size 1 scoop (29.646g)

Amount Per Serving	
Calories	150
	% Daily Value *
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	0%
Cholesterol 0mg	0%
Sodium 40mg	2%
Total Carbohydrate <1g	**
Dietary Fiber 0g	0%
Total Sugars 1g	
Includes 0g Added Sugars	0%
Protein 25g	
Vit. D 0g 0%	Calcium 120mg 12%
Iron <1g **	Potassium 150mg 4%

*The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2000 calories a day is used for general nutrition advice.
**Contains less than 2% DV

Typical Amino Acid Profile per Serving	Vanilla
Alanine	1372 mg
Arginine	588 mg
Aspartic Acid	2856 mg
Cystine/Cysteine	672 mg
Glutamic Acid	4648 mg
Glycine	420 mg
Histidine	420 mg
Isoleucine* †	1792 mg
Leucine* †	2744 mg
Lysine*	2632 mg
Methionine*	588 mg
Phenylalanine*	784 mg
Proline	1624 mg
Serine	1232 mg
Threonine*	1876 mg
Tryptophan*	560 mg
Tyrosine	784 mg
Valine* †	1456 mg

*Essential Amino Acids
†Branched Chain Amino Acids (BCAAs)

Other Ingredients: Whey Protein Hydrolysate, Inulin (Fructooligosaccharides) Sunflower Lecithin (Emulsifier), Natural Vanilla Flavor, Stevia
Allergen Statement: Contains Milk

Figure 4– Example of Hydrolyzed Whey Protein & ingredients (amino acid profile)

Whey Protein Hydrolysates

It is produced through **enzymatic hydrolysis** of either concentrate or isolates. The peptide bonds are separated through this process resulting in a **reduced digestion time**.

Benefits of different types of protein

Whey Protein Isolates

- Whey protein can help increase antioxidant levels and boost immune system.
- Contains the best combinations of amino acids to improve body composition and athletic performance
- Hormonal responses can be heightened
- Highly soluble and absorbed by the body more quickly than other proteins. This is useful as a fast nourishmentCan aid in weight management by stabilizing blood glucose levels, lowering hunger, and taking more energy to digest than other foods

Whey Protein Concentrate

- Provides the same benefits as whey protein isolate, but less efficiently

Hydrolysed Whey

- Hydrolysates have been partly broken down through heat, acid or enzymes that break up the bonds that link amino acids. It is for this reason that hydrolysates taste bitterer. But on the other hand it is better absorbed in the stomach. If you can stomach the taste, hydrolysates is for you.

Natural sources of Protein

Egg Protein

- Eggs are one of the most versatile and complete foods
- Eggs contain about 6g of high quality protein
- It is often used as the standard against which other foods are measured
- Eggs are a rich source of vitamins (A, E, K & B). Eggs contain all the essential and recovery from exercise. It contains calcium, zinc and iron amino acids needed for muscle building

The word "protein" is from the Greek word proteios, which means "primary" or "holding the first place." The term was first used in 1838

Hemp Protein

- Hemp protein powder is a popular variety which is made by grinding pressed hemp seeds into a fine powder. It has a nutty taste and is often added to shakes to boost protein intake
- Hemp is a high quality vegan protein – it contains all nine essential amino acids, fiber, healthy fats and minerals.
- Hemp has relatively low levels of the amino acid Lysine – this makes it a poorer quality option
- 30g of hemp protein = 15g of protein. That is less protein per serving than whey or pea protein

Soy Protein

- Controversial food source at the moment. Many people believe soy is a good alternative protein, but recent research has linked soy protein to increased estrogen levels, which could lead to cancer.
- Soybeans are a good source of protein. They are not as complete as meat or eggs, but they are superior to other plant proteins. Processing soy at high temperatures can denature some of the proteins and in the process reduce their quality.
- The fatty acids in soybeans are generally Omega-6 polyunsaturated fats. This can be tricky because too many Omega-6s in the diet can lead to inflammation and all kinds of health problems. It for this reason that it is advised to avoid soybean oil (and other vegetable oils which are high in Omega-6) and other processed foods which may contain it.

Meat Protein

- Meat is simply muscle tissue. It is high in protein content and contains all the essential amino acids.
- Red meat contains additional nutrients like zinc and iron.
- Meat take longer to digest than powders. This makes one to be full for longer periods and therefore preventing hunger

List of top 10 sources of protein

FOOD Name	Calories	Protein	Total Fat	Sodium	Potassium
1. Turkey Breast (100g)	147	30 g	2.08 g	99 mg	249 mg
2. Chicken Breast (100g)	172	21 g	9 g	63 mg	220 mg
3. Fish (Tuna, Salmon) (100g)	87	19 g	0.7 g	31 mg	392 mg
4. Cheese (28 g)	371	18 g	32 g	1,671mg	132mg
5. Pork Loin (Chops) (100g)	157	21 g	8 g	64 mg	372 mg
6. Lean beef & veal (low fat) (100g)	250	26 g	15 g	72 mg	318 mg
7. Tofu (100g)	76	8 g	4.8 g	7 mg	121 mg
8. Beans (mature soybeans) (100g)	446	36 g	20 g	2 mg	1,797 mg
9. Eggs (100g)	155	13 g	11 g	124 mg	126 mg
10. Yogurt (100g)	59	10 g	0.4 g	36 mg	141 mg

Table 2 – list of top 10 sources of protein