FUNCTIONAL INGREDIENTS

Proteins pave the way for increased performance

By Kara McDonald
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*Protein provides optimal benefits and functionality for performance-product formulations. **Kara McDonald** sifts through protein concentrates and isolates to find the most suitable types for your next product launch*

Protein has long been a favourite of serious athletes due to its ability to stimulate muscle growth and recovery, which may ultimately help to enhance athletic performance. Once just a staple in the bodybuilder's tool kit, today's mainstream consumer is picking up on the power of protein, realising how this important nutrient can help build lean muscle and improve body strength.

But how does protein provide muscle benefits, and do protein sources differ in their ability to positively impact muscle? Most importantly, how can manufacturers in today's competitive functional food and beverage industry tap into the power of protein ingredients to use in products that maximise the consumer benefit?

Why the body needs protein

Athletic performance and recovery from exercise are enhanced by optimal nutrition, which includes the selection of proper food and beverage choices as well as the timing of intake, according to a Joint Position Statement published by the American College of Sports Medicine (ACSM), American Dietetic Association (ADA), and the Dietitians of Canada (DC).[1]

Protein plays a crucial role in the building of lean muscle and muscle recovery. Following intense resistance exercise, many athletes make use of ingesting protein to maximise muscle hypertrophy, or an increase in muscle-fibre size (though there are some athletes, like runners or cyclists, who do not want to carry the additional weight). The amount of protein the body needs varies depending on age, weight, sex, activity level and overall health. The Institute of Medicine recommends a range from 10 per cent to 35 per cent of daily calories consumed come from protein for the average healthy adult.[2] For example, if a 155-pound person eats 2,000 calories every day, this would be between 50g to 175g of protein per day. Research has shown that some athletes and routinely active adults may benefit from additional dietary protein. Protein recommendations outlined in the Joint Position Statement

from ACSM/ADA/DC for endurance and strength-trained athletes range from 1.2 to 1.7g/kg body weight/day, which is an aggregate total of between 84 and 119g/day.[1]

While proteins are all good, the quality varies based on composition. An ideal sports protein should provide a high proportion of essential amino acids, particularly branched-chain amino acids (BCAAs), especially leucine.

Quality matters

Evidence suggests that consumption of different proteins can affect the extent and possibly the duration of muscle protein synthesis (MPS) after feeding, and this effect is potentially accentuated with resistance exercise.3 A high-quality protein source can be used for the maintenance, repair and synthesis of skeletal muscle proteins in response to training.[3]

The advantage of whey protein is that it contains all the essential amino acids the body needs to build and repair muscle after a tough workout. Whey protein also is one of the richest sources of BCAAs, which helps athletes get the most out of their workouts. (See accompanying chart on BCAAs.) BCAAs are unique because they can be taken up directly by skeletal muscle and used in rebuilding muscle after exercise.

"The branched chains, and particularly leucine, are the key amino acids one should look for in a performance product," said Matthew Pikosky, PhD, RD, FACN, and director of research transfer for Dairy Management Inc (DMI). "Leucine is a key nutrient signal initiating protein synthesis, and the branched chains are collectively unique compared with the other amino acids in that they are preferentially taken up and utilised by skeletal muscle."

Weighing the differences

High-quality proteins such as whey, casein and soy can support MPS, but differences in the rate of digestion of these proteins may modulate MPS response after an acute bout of resistance exercise and following long-term training. Another important component in determining the effect on MPS may be the leucine content of the protein. According to research conducted by the Exercise Metabolism Research Group at the Department of Kinesiology, McMaster University, Hamilton, Ontario, when seeking to maximise MPS, milk proteins and their isolated forms, such as whey and casein, may offer an anabolic advantage over soy proteins in promoting muscle hypertrophy.[3]

Research also has shown that whey protein works well for workout recovery products. If combined with a high-glycaemic carbohydrate, it provides quick muscle-recovery effects compared to ingesting only carbohydrates post-exercise, according to additional research conducted by the Exercise Metabolism Research Group at McMaster University in Hamilton, Ontario.[4] In a study using eight resistance-trained athletes, the researchers found that participants who ingested a carbohydrate drink (21g of fructose) containing 10g of whey protein following resistance exercise saw a

greater increase in MPS compared to a carbohydrate-only beverage. However, this may be in part due to the poor absorption associated with fructose.[5]

Studies are now beginning to examine how protein hydrolysates consumed before, during or after workouts impact muscle recovery.[6] Protein hydrolysates are produced from purified/intact protein sources by heating with acid or, preferably, an addition of proteolytic enzymes, followed by purification procedures. Because these proteins are partially broken down or digested, the amino acids are able to reach the blood and skeletal muscles more quickly.

One study at Victoria University in Victoria, Australia, examined the effects of supplementation with hydrolysed whey isolate and casein on strength, body composition and plasma glutamine levels during a 10-week, supervised resistance training programme in a group of male recreational bodybuilders.[7] The study found that whey-protein hydrosolate was more effective than casein at helping these athletes achieve significant gains in muscle strength and lean body mass. Additional research is still needed in this area to compare intact proteins to partially hydrolysed proteins to determine if these differences in speed of digestion and absorption result in a practical benefit (ie greater MPS, muscle strength, etc.).

Pick your protein

In addition to differences in their amino acid composition, dairy proteins like casein and whey vary in their digestion/absorption and delivery of amino acids to the skeletal muscles. Casein is described as a 'slow' protein because of its slower rate of digestion, resulting in a prolonged delivery of amino acids to systemic circulation. Casein's primary benefit is suppressing whole body protein breakdown.[8] In contrast, whey protein is known as a 'fast' protein because it is digested rapidly, leads to a large but transient increase in blood levels of amino acids and stimulates protein synthesis and oxidation.[9] There is emerging evidence now on new protein forms such as whey growth-factor extracts, which could possess biological properties including tissue repair and anti-inflammatory activity.[10]

Research continues on discovering new ways and opportunities for performance food and beverage manufacturers to use protein ingredients to boost protein content in their products and help today's performance athletes reach new goals.

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Who is using whey in performance products? Frequently used in performancebeverage product formulations, whey proteins maintain solubility across a wide range of pH levels. "The beauty of formulating with dairy protein ingredients is that one can choose which to use based on the pH conditions and the beverage's heat stability requirements," said Kimberlee Burrington, dairy ingredient applications coordinator, Wisconsin Center for Dairy Research at the University of Wisconsin-Madison. In addition, whey proteins have superior gelling and water-binding capabilities.

Specialty whey-protein concentrates and isolates can be the performance product formulator's protein of choice to develop a clear beverage or pack 20g of protein into the performance athlete's nutrition bar. These concentrates and isolates can be found in heat-stable, high-gelling, partially hydrolysed or other speciality forms to meet the ingredient challenge.

"If clarity is the goal for the beverage product, the ingredient of choice is whey-protein isolate, which has more than 90 per cent protein and very low levels of fat," Burrington said. "For hot-fill products, clear beverages can be formulated in the pH range of 2.8 to 3.4 and cloudy beverages in the pH range of 3.5 to 4.5."

Whey proteins are least stable near their isoelectric point, but are quite soluble above or below this pH. Solubility can decrease with severe heat treatments that denature whey proteins, which makes them less soluble. Performance food and beverage products on the market today use whey protein at varying levels depending on the market:

- Nature's Best's 100% Whey Protein Isopure Smoothie with flax that delivers 260mg ALA omega-3 in addition to 32g whey protein in three 16oz shelf-stable yoghurtlike flavours. This whey protein smoothie extends their line of 100 per cent whey protein beverages, which is anchored by Isopure Zero Carb with 40g whey protein isolate.
- A similar high-protein, high-acid beverage is Cytosport's Cytomax Pure Protein drink that also delivers 40g protein in a 20oz bottle targeted at bodybuilders and high-level athletes.
- Mix 1 has seven protein and antioxidant drinks that utilise whey protein as its sole source of protein. Mix 1 is an all-natural, balanced nutrition beverage for busy people.
- Benevia has four nutrient-enhanced, fruit-flavoured drinks. The company offers a clear light version of adult nutrition beverages with 6-8g whey protein in each of four SKUs.

— KM

The branched-chain gang

Whey protein offers several benefits for the physically active. Easily digestible, the dairy protein is a high-quality protein with a relatively high proportion of branched-chain amino acids (BCAA) such as leucine, which plays a significant role in the rebuilding of muscle. The abundance of leucine in whey plays a significant role in the synthesis of muscle protein. See chart below for comparison of BCAA content of different protein sources.

Branched-Chain Amino Acid Content of Foods

	Branched-Chain Amino Acids		
	Natural Source Examples		
	Leucine	**Isoleucine**	**Valine**
1 scoop (36g) of whey-protein isolate	3.2g	1.8g	1.7g
1 scoop (36g) soy-protein isolate	2.4g	1.5g	1.5g
4 oz. sirloin steak	2.0g	1.1g	1.3g
4 oz. chicken breast	2.0g	1.4g	1.4g
1 cup low-fat yoghurt	1.1g	0.6g	0.9g
1 cup skim milk	0.8g	0.4g	0.4g
1 egg	0.5g	0.3g	0.4g
2 tbsp peanut butter	0.5g	0.2g	0.2g
1 slice wheat bread	0.1g	0.05g	0.07g

Source: USDA National Nutrient Database for Standard Reference, Release 20 and GNC WPI 28

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