More than muscle
Exploring the additional benefits of hydrolysed whey protein
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Introduction

Whey protein has long been the benchmark ingredient for sports nutrition. Athletes choose whey protein for its well-established muscle building capabilities. However, with sports nutrition moving mainstream, elite performers now seek differentiated products to deliver more specific physiological benefits. New evidence is emerging, proving the link between whey protein and other, more diverse bioactivities that are valuable in supporting athletic performance. By harnessing this information, there is increased potential for manufacturers and brand owners to promote the role of hydrolysed whey protein in delivering enhanced physiological benefits in combination with training. This white paper discusses the scientific evidence demonstrating the ability of hydrolysed whey protein to improve physiological adaptation to training as well as offering additional potential health benefits to athletes.
What is hydrolysed whey protein

Intact whey protein offers many nutritional benefits; complementing the already widely utilised whey protein concentrate (WPC) and whey protein isolate (WPI) is whey protein hydrolysate (WPH).

WPH can be either WPC or WPI that has undergone an additional step during the manufacturing process. This step includes the addition of targeted enzymes that break down the larger intact proteins present in concentrate and isolate into smaller proteins, peptides and free amino acids. These smaller components can be rapidly digested and absorbed, resulting in faster presentation of amino acids to the muscle relative to their intact counterparts. In addition to quicker digestion, absorption and enhanced digestive comfort, these smaller proteins and peptides can have greater bioactive potential than the larger intact proteins.

Release of these smaller bioactive proteins and peptides during manufacturing allows them to interact with receptors in the stomach and the small intestine immediately upon ingestion, resulting in an augmentation of the typical physiological response to intact protein ingestion. This can manifest as an enhanced insulin response, resulting in the rapid clearance of nutrients into muscle and improved antioxidant and immunomodulatory responses, which could contribute to a reduction in post-exercise muscle damage and a reduction in the incidence of illness (coughs, colds and flu) respectively. These benefits, currently being investigated further by Carbery in collaboration with research partners, are detailed below.
Biological benefits of hydrolysed whey protein

3.1 Digest the benefits
Many of the typical symptoms of gastrointestinal (G.I.) discomfort (bloating, belching, flatulence) associated with intact protein ingestion can be alleviated in sensitive individuals when they consume whey protein in hydrolysed form. It is likely this is a result of the breakdown of the larger intact proteins that can be responsible for the G.I. discomfort (including β-lactoglobulin or α-lactalbumin) into smaller protein and peptide forms. Extreme exercise can also cause digestive disorders such as nausea and diarrhoea, especially in endurance athletes\(^1\). Acute gastritis and acid reflux can also be brought about by strenuous or lengthy training sessions or competition. These conditions dramatically impede an athlete’s performance, and a nutritional intervention designed at maintaining a healthy digestive system proves advantageous. Hydrolysed whey protein’s positive effect on digestive function further enhances the possibilities for its use as an ingredient in products designed to support elite performance.

3.2 Diversity in the gut
The influence of gut microbes on health, and in particular immune function, has been highlighted by recent advancements in that field of study. Loss of biodiversity and disturbances to gut microbiomes have been associated with the onset of gastrointestinal illnesses. A broader diversity of gut microbiota has also been linked to improved health. There is evidence to suggest that exercise may alter gut microbiota\(^2\) and therefore that elite athletes should display a more varied and active gut microbiota than non-athletes. This correlation, however, may also be linked to the differing diets of elite athletes and their high protein consumption. As whey protein supplements normally account for a significant proportion of the protein in athletic diets, whey protein may be the crucial factor in altering gut microbiome diversity, leading to the prevention of various diseases. More investigation is needed to analyse the correlation between protein and gut microbiota diversity and the extent to which hydrolysed whey protein in particular can enhance this effect.

3.3 The road to recovery
Whey is the ingredient of choice for individuals undertaking resistance exercise with a view to increasing muscle mass, power and strength, due to its excellent digestion and absorption kinetics and high essential amino acid (and in particular leucine) concentration. For elite endurance athletes, the rate at which they can recover from training and/or competition affects how quickly they can undertake their next session and, in turn, adapt to a higher level of performance. Glycogen, the body’s main storage form of glucose, serves as an energy reserve and its replenishment is crucial in recovery from endurance exercise. During intense exercise, the body’s glycogen stores are depleted, so re-synthesis is important in support of subsequent training sessions. Studies during the 1980s and 1990s suggested that glucose uptake\(^3\) and glycogen synthase activity\(^4\) are enhanced by elevated insulin levels, so researchers’ attention has focused on how whey protein, in combination with carbohydrate, may increase insulin levels and aid glycogen re-synthesis in response to endurance exercise.

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Power et al. demonstrated that whey protein is effective at promoting insulin secretion. The peak plasma insulin concentration of participants in this study was further augmented with the consumption of WPH as compared to WPI. In a more recent study, the same authors confirmed the relationship between WPH and enhanced insulin secretion. Van Hall et al reported that plasma insulin concentration following the ingestion of WPH in combination with carbohydrate was almost double that of the response to carbohydrate only ingestion. This elevated insulin response translated into a 20% increase in the rate of muscle glycogen re-synthesis (critical for fuelling subsequent exercise bouts) above that achieved by carbohydrate only. This data substantiates the use of whey protein hydrolysates in post-workout applications as an effective strategy to enhance post-exercise muscle glycogen re-synthesis in endurance athletes. These benefits are in addition to those that WPH ingestion provides in terms of increasing muscle protein synthesis, repair and reconditioning post exercise.

3.4 Improved defence

High intensity exercise has been linked with the generation of free radical reactive oxygen species (ROS) whose excess production is related to a number of issues such as muscle cell damage, muscle soreness and inflammation. This is where antioxidants come in. They can safely interact with the ROS to inhibit cellular damage and prevent excessive oxidative stress. This ability may aid in muscle recovery and adaptation post exercise. Recent research carried out by O’Keefe et al indicated that WPH has a significantly greater antioxidant capacity than unhydrolysed WPC. This is further supported by the Power-Grant et al study referenced earlier, which also showed that enzymatic hydrolysis dramatically enhanced whey’s antioxidant activity compared to its intact version. This has implications for the use of WPH in elite athlete nutrition products specifically for the purpose of increasing antioxidant activity and reducing post-exercise muscle damage, soreness and inflammation.

3.5 Protecting the body

Linked to the importance of appropriate antioxidant activity is the need for a strong immune system. A healthy immune system is essential for athletes to maintain their health during extended periods of strenuous training. Although moderate exercise has a favourable impact on immunity, repeated bouts of high-intensity exercise has been shown to increase the risk of developing instances of upper respiratory tract infections (URTI). In order to lower the risk of infections, athletes may have to reduce the frequency and intensity of their training programs, which could impact their long-term performance and adaptation. It is clear then, that athletes would benefit from ingredients with positive immunomodulatory effects in their diets. A number of anti-inflammatory effects derived from whey proteins and whey-derived peptides, including the inhibition of cytokine release, has been reported previously. Modulating the immune response to exercise through appropriate nutrition could therefore reduce the incidence of illness among athletes and ensure they remain healthy and in a position to maintain their performance.
4.1 More than just muscle

As we can see from the research highlighted above, hydrolysed whey protein such as Optipep® has far more advantages relevant to elite athlete nutrition than previously understood. Nonetheless, the more established benefits still remain important. Whey in all its forms – concentrate, isolate and hydrolysate – is a source of high quality protein. Hydrolysed formats offer additional benefits over and above intact whey proteins because the smaller proteins, peptides and amino acids are more rapidly absorbed, meaning its physiological benefits are felt more quickly. For elite athletes who often complete multiple sessions in a single day and so cannot afford long periods of recovery and repair between sessions, these fast absorption benefits are extremely appealing.

Recovery and repair aside, we have now displayed that hydrolysed whey protein in particular may contribute to the enhancement of many other physiological systems. This innovative ingredient may support several biological functions, which all contribute to improved athletic performance. The research published to date will continue to be expanded on, and provides the basis for the scientific proof of efficacy that WPH can be used as a highly functional ingredient in elite athlete nutrition for reasons additional to muscle building, repair and recovery. Less obvious but equally important areas of health, such as immune function and antioxidant activity, also need to be supported when exercising intensively and regularly. The scientific literature increasingly shows that hydrolysed whey protein can provide that support.

4.2 The taste of success

The realisation that WPH can enhance bioactivities relevant to sports performance means its application opportunities will continue to broaden. Product categories within performance nutrition, such as pre- and intra-workout, bars and RTDs are likely to become more segmented as athletes seek to target specific physiological benefits related to individual products. WPH is well positioned for these new product formats and formulation challenges. It can provide superior softness in a protein bar without compromising on the quality protein source, for instance. In addition, a heat stable WPH can also be used in neutral pH ready to drink protein beverages, delivering product stability over a twelve month shelf life.

Manufacturers interested in formulating with WPH are tasked with overcoming the bitter taste profile common to many hydrolysates. Carbery’s Optipep® are a range of advanced hydrolysed whey proteins that offer the perfect balance between a great taste experience and a targeted nutritional impact. This, in combination with masking solutions and high impact authentic flavours developed specifically for WPH by our taste division, Synergy Flavours, ensures we can support formulators in optimising the taste of even the most challenging formulations.

Along with robust scientific evidence of nutrient efficacy, eliminating the compromise between taste and performance is without doubt one of the critical success factors for elite sports nutrition manufacturers.
Carbery is a leading global manufacturer of nutritional dairy ingredients as well as flavours and cheeses. For over 50 years, the company has brought innovative and high quality ingredients to the sports nutrition industry, helping customers create great tasting, healthy food experiences enjoyed by consumers worldwide.

Carbery is a key member of Food for Health Ireland (FHI) – a partnership of leading academic and government research organisations and major dairy processors in Ireland. FHI aims to identify bioactive ingredients that can be derived from milk, ensure that any components found satisfy real consumer needs and accelerate their commercialization.

For more information please visit:
http://carbery.com/nutrition/our-focus/performance-nutrition/