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As plant-based foods grow in popularity, sound nutrition is a top priority. Protein is one of the most important variables as plant foods typically contain substantially lower total protein content per serving than animal-based foods. Though active consumers have an array of products to satisfy their taste buds, they may fall short on one or more nutrients that can support athletic performance and health. **Marie Spano** identifies the market's plant ingredient opportunities, as well as their respective nutrient and protein offerings.



## 10 Collagen's performance benefits

Specific collagen supplementation regimens offer a unique value proposition in sports nutrition products. Collagen supplementation might not only play a role in treatment of injury and osteoarthritis but may also play a role in prevention of injury, therefore supporting bone and joint health of a young and active population and helping them stay active throughout their lifetime. **Professor Robert Hickner** explains where the potential of collagen lies for sports nutrition products.



## 13 Bone and joint support for athletes

With collagen now gaining traction in the sports nutrition arena, **Suzane Leser** talks about how supportive research is positioning collagen peptides amongst the top sought-after supplements for athletes. New studies also reveal results that may offer insight to combating challenges of efficacy and nutrient interactions.



## 15 Peptide power

Nutrition in sports plays an important role in meeting consumer needs associated with physical performance, exercise stress and recovery. Diet and supplementation have been positioned to support active consumers before, during and after a workout. **Dr. Dietrich Rein** and **Mareike Kampmann** discuss the importance of new-to-market peptides that address inflammatory processes in exercise.



## 19 Takeaways



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# The future's green

**Once focused primarily** on the professionals, the sports nutrition market now caters to a range of consumers—from general gym-goers to high performance athletes. Several segments within the health and nutrition industry are converging to develop advanced quality products; a prime example is the convergence of sports nutrition and plant-based ingredients.

Many people have made lifestyle changes to incorporate more plants into their diet—ranging from committed flexitarians to full-on vegans. Coupled with the fact that mainstream consumers are also prioritising ethical and environmental concerns over straight performance benefits, plant-based proteins have had swift entry to the sports nutrition market. Innova Market Insights revealed that 14% of sports nutrition launches in 2018 featured a vegan claim, and there were three times more sports nutrition launches with pea protein in 2018 than in 2014. But while consumers are looking for alternative protein products, not all proteins are created equal and a primary challenge is nutrient content.

Pea and rice protein are popular alternative protein frontrunners, but often overlooked is protein digestibility-corrected amino acid score (PDCAAS), which measures the quality and digestibility of the protein based on amino acid profile. Soy remains the only 'complete' plant protein, but some plant products use a combination approach—like pea and rice protein—because together, they offer higher amounts of essential amino acids.

In an overview of plant proteins for the sports nutrition market, Marie Spano highlights new ingredients, essential micronutrients, and challenges pertaining to formulation and efficacy. Beyond nutrition and protein, athletes are also concerned with muscle recovery, inflammation reduction and injury prevention. Although typically known for its bone and joint health benefits, collagen is increasingly under the sports nutrition spotlight, with more research and science securing its place in the market. Prof. Robert Hickner outlines where the potential lies for collagen in sports nutrition products, while Suzane Leser looks into how the ingredient supports stronger tendons and ligaments for amateur and professional athletes. Lastly, peptides are known for their benefits in post-performance recovery; Dr Dietrich Rein and Mareike Kampmann provide a case study of the artificial intelligence-enabled discovery of immune active peptides geared toward sports nutrition.

All this leaving you inspired? If you're attending Vitafoods Europe in May, don't forget to sign up for our 5K run or yoga wellness session!



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# Powering the active consumer

## Nutrient needs that complement plant-based diets

by Marie Spano



**Once trendy, plant-based eating** is now mainstream. Driven by media articles, all-inclusive branding that conjures thoughts of good old fashioned farming without the commitment of going vegan, and a timely explosion of flavours and formats, plant-based eating is here to stay. Though active consumers have an array of products to satisfy their taste buds, they may fall short on one or more nutrients that can support athletic performance and health. Educated consumers will start demanding foods and beverages with complementary proteins, omega-3 fatty acids, creatine, iron, zinc and other micronutrients.

### Powerful Plant Proteins

Jeroen Wouters, PhD, Innovation Manager Sports and Nutrition at the Dutch Olympic Training Centre Papendal, is seeing an increased interest in alternative protein sources. He evaluates proteins carefully to ensure elite athletes are meeting their nutrition needs as they satiate their desire for food closer to the ground. “We look into the quantity of protein provided per serving, the source of protein as well as the amino acid composition,” Wouters said. “In addition, we are eager to learn more on the relevance and efficacy of novel or plant-based protein sources on sports-associated characteristics such as recovery and muscle generation.” With the exception of soy and wheat, plant proteins have far less research compared to animal-based proteins. “There is much more to be learned and gained on this topic, such as digestibility,” he added.

Plant protein combinations that are complete, providing all essential amino acids (EAAs), and also have fewer anti-nutrients, which bind amino acids making them less bioavailable, will rise to the top. Only essential amino acids are used to build muscle; the body can make all non-essential amino acids.

Soy is the only complete plant protein and it has a PDCAAS (protein digestibility-corrected amino acid score) higher than most other proteins. PDCAAS is a measure of a protein’s quality based on its amino acid profile and the ability of humans to digest the protein. Though soy has a naturally beany flavour, food processing can remove or deodorise this, leaving this protein with a relatively bland flavour that can be used in a wide variety of applications.



According to research by FMCG Gurus Ltd., rice protein tops the list as the most recognisable plant protein. Rice protein powder provides a smooth texture in beverages and is a non-allergenic protein. However, rice is limited by its lysine content. Combining rice with beans, whether as whole food or via protein powder, makes a complete protein.

Pea protein is rapidly growing in popularity with a projected compound annual growth rate of 17.4%. Though pea protein falls short on methionine and lysine, it is relatively high in leucine, the amino acid that turns on the process underlying muscle growth. Peas and rice make a complete protein containing all EAAs in sufficient quantities. Known as a non-allergenic protein, pea protein is used in everything from cheese and dairy-free milk alternatives to pasta and baked goods.

Pulses, including beans, peas, chickpeas and lentils are gaining ground, particularly in pastas, crackers and other baked goods. Pulses are a good source of vitamins, minerals, fibre, resistant starch, protein and beneficial plant compounds. Though rich in nutrition, pulses contain many anti-nutrients, although processing can help decrease their anti-nutrient content. Pulses are nutrient-packed, visually appealing, and available in a wide variety of textures including roasted pulses, grits, flakes, raw flours, air classified flours, pre-cooked flours, pre-gelled flours, pastes, pulse/cereal blends, protein isolates, and protein concentrates. Pulses are a good fit for soups, pasta, salads, chili, bakery items, chips, pastes, dips, cereals, extruded snacks, nutrition bars, powdered supplements and as thickeners.

Lentils are an excellent source of fibre and a good source of iron and vitamin B6. Lentil flour can be used to add texture and good nutrition to sweet and savory applications. From breads and sweets to pasta, lentil flour is quite versatile. Methionine and cysteine are the limiting amino acids for lentils. Though the PDCAAS for lentils is much lower than that of whey and soy, processing improves the amino acid bioavailability, giving lentil flour a higher PDCAAS than lentils.<sup>3</sup>

### Omega-3 fatty acids

Those avoiding fish can add natural sources of alpha linolenic acid (ALA) including hemp seeds, chia seeds, flaxseeds, walnuts, and plant oils including flaxseed and soybean oil to meet their omega-3 fatty acid needs. While these foods help cover the bases for meeting one's essential fatty acid (EFA) needs, miniscule quantities of ALA are converted into eicosapentanoic acid (EPA) and docosahexaenoic acid (DHA) in the body. EPA and DHA are incorporated into cell membranes where they make membranes more elastic, flexible and less prone to



damage. They also influence membrane functioning and modulate the inflammatory response after exercise. DHA is also the major fat found in the brain and eye.

The only way to get EPA and DHA from plants is to dine like fish do—eating certain types of algae that are rich in these fatty acids. Because algae could be a little more difficult to formulate into certain foods and beverages, EPA and DHA ingredients produced from algae may be a more viable option that still meets the criteria for ‘plant-based.’

If ALA is acceptable in order to meet omega 3 packaging claims, ALA-rich seeds and nuts will do the trick. Hemp seeds, chia seeds, flaxseeds, and walnuts also add taste, texture and a package of nutrients. Hemp seeds fall short on two EAAs—leucine and lysine—but they are an excellent source of iron, thiamin, phosphorus, magnesium (45% of the DV), zinc and manganese, and a good source of vitamin B6 and folate. Iron and magnesium are notable as iron is tough to find in plant foods while magnesium is in a number of foods but generally in fairly small quantities. Magnesium is a mineral that may hit the spotlight as more athletes are recognising its role in energy production, muscle contraction and relaxation. Hemp has a subtle flavor allowing it to play well with many flavour profiles and food applications.



“Magnesium may hit the spotlight as more athletes are recognising its role in energy production, muscle contraction and relaxation.”

In addition to ALA, chia seeds are an excellent source of fibre and a good source of magnesium. Chia seeds have a mild flavour making them an easy ingredient to use in a wide variety of applications from baked goods to salads and puddings.

Flaxseeds are a good source of fibre and magnesium. They offer a nutty flavour and seed-like crunchy texture to foods though they can also be incorporated in ground form, making the nutrients easier for the body to use. Flaxseeds can be found in breads, soups, dressings and dairy alternatives.<sup>8</sup>

### Creatine monohydrate

Creatine monohydrate is one of the most researched ergogenic aids. Creatine lends a phosphate group to ADP (adenosine diphosphate) to make it ATP (adenosine triphosphate), which is used as energy for muscle contractions during high intensity exercise. When taken consistently over time and in combination with resistance training, creatine monohydrate increases strength and lean body mass in younger and older adults.

Creatine is produced in the body; however, ingesting creatine in the diet helps maintain higher levels in the muscle. The main sources of creatine are meat and fish. Going on a vegetarian diet leads to a significant decrease in muscle creatine content compared to eating an omnivore diet.



### Micronutrients

Iron is necessary for growth, development, cell functioning, immune functioning, synthesis and functioning of some hormones as well as the proteins hemoglobin and myoglobin. Hemoglobin transfers oxygen throughout the body while myoglobin transports oxygen to muscles. Iron from animal foods (heme iron) is better absorbed than the type of iron found in plant foods (non-heme iron) that is bound to naturally occurring plant compounds that interfere with iron bioavailability. White beans, tofu, chickpeas, spinach, and lentils are excellent plant-based sources of iron.

Zinc is essential for immune health, skin integrity, wound healing, the metabolism of carbohydrates, proteins and fats, gene expression, red blood cell functioning, normal taste and smell, as well as growth and development. Subpar zinc intake can impair energy, and athletic performance, muscle strength and power output. Marginal zinc deficiency is associated with low levels of testosterone, and other hormones.<sup>14</sup> Zinc is not stored in the body and therefore must be consumed daily. The best sources of zinc are animal foods. However, cashews and baked beans are good plant-based sources of this mineral.

Calcium is involved in hormone secretion and nerve transmission, constricting and dilating blood vessels, and acts as an intracellular messenger supporting muscle contraction. Calcium keeps bones and teeth strong and functioning properly. When calcium is in short supply, the body will pull from its backup supply in bone to keep levels within the blood constant. Turnip greens, kale, and soybeans are good sources of calcium.

Though the body can make vitamin D when the skin is exposed to UVB rays, insufficient levels are common, even in those who live in sunny climates. Vitamin D helps to maintain blood calcium and phosphorus levels as well as uptake of inorganic phosphate for normal bone mineralisation and muscle functioning. Vitamin D deficiency leads to weak type II fibres, impaired muscle contraction and relaxation, decreased strength, and a potential decline in athletic performance and increased risk of bone injuries.

Vitamin D2 is the best plant-based option as it is made from irradiating fungus or yeast. Vitamin D is best formulated in foods or beverages with some fat, which is necessary for optimal absorption.





As plant-based foods grow in popularity, sound nutrition is a top priority. Protein is one of the most important variables as plant foods typically contain substantially lower total protein content per serving than animal-based foods. For those forgoing fish, omega-3s may be a shortfall nutrient, although adding ALA-rich foods or EPA and DHA can help meet omega-3 needs. For the serious athlete looking to improve strength or endurance, creatine is important. Other shortfall nutrients for those on a mainly or all plant-based diet may include zinc, calcium, vitamins D and B12. Ingredient awareness is key as discerning customers want more than great taste. They opt for plant-based because they perceive it to be healthier than animal foods. Therefore, a food or beverage that delivers on taste and sound nutrition will win the tug-of-war for valuable shelf space in grocery stores. ●

Marie. A. Spano is the sports dietitian for the Atlanta Hawks and Atlanta Braves and works with a variety of athletes through her company Spano Sports Nutrition Consulting, LLC. She is co-editor of the NSCA's *Guide to Exercise and Sport Nutrition* (Human Kinetics Publishers) and a freelance journalist for *FitnessRx for Women*, as well as several trade publications.

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# Collagen's performance benefits

## Where does the potential lie for sports nutrition products?

by Prof. Robert Hickner

**A**thletic competitions, especially professional sports, are becoming increasingly competitive, resulting in high incidence of repetitive use and traumatic injuries. Even in recreational sports, musculoskeletal injuries are common, often due to improper warm-up or technique, or overtraining. Injury avoidance and successful recovery from acute and chronic training are major factors in continued optimal performance. I say this not only as a researcher, but as a lifelong athlete and past Hawaii Ironman World Championship Triathlon competitor. Chronic overuse can also result in acute and permanent injury or disability. In the United States alone, 33 million musculoskeletal injuries per year have been reported, 50% involving tendon and ligament injuries.<sup>1</sup> Furthermore, individuals who sustain injuries of the knee are four times more likely to develop a chronic condition of knee osteoarthritis (OA).<sup>2</sup>

### Why collagen in sports nutrition?

Collagen is comprised of amino acids that are the building blocks for the connective tissue that is present in every major tissue in the body. Collagen acts as a 'glue' by connecting and keeping cells and tissues together. As we age, our collagen levels drop, resulting in decreases in skin elasticity, joint mobility, bone mineral density and muscle quality, all of which contribute to reductions in physical performance and increase injury risk.

### Collagen and inflammation

Collagen supplementation has potential benefits in offsetting inflammation, and one of the main reasons is likely the presence of glycine, one of collagen's major structural units. Glycine improves biomechanical properties of the Achilles tendon following inflammation, which is one of the typical injuries occurring in sports involving the lower body. There is emerging evidence that glycine might also be beneficial in individuals suffering from OA. There is likely a dose-dependency and duration of intake of collagen peptide that is most optimal for this, and other, effects of collagen supplementation.

### The impact on bone and joint health

Many clinical studies suggest orally-administered collagen peptides may have beneficial effects on bone and joint health by increasing bone mineral density (BMD) and physical strength of the bones as well as alleviating pain, maintaining mobility and minimising disability of the joints. In bones, osteogenesis is stimulated by small collagen peptides while bone resorption is reduced, leading to increased BMD and bone strength. In joints, collagen peptides can protect and rebuild cartilage and ligaments, resulting in improved mobility as well as

reduced stiffness and pain that may result from tissue damage and swelling of the joints.<sup>3</sup>

### Muscle performance, and injury prevention

According to an in-vitro study, specific collagen-derived peptides might help to maintain muscle tissue by inducing cell differentiation and skeletal muscle hypertrophy.<sup>4</sup> These findings imply that the specific amino acids present in collagen peptides could have a beneficial effect on muscle recovery from exercise. In recent years, collagen in combination with vitamin C has gained significant attention in scientific literature for the potential role of this combination in injury prevention and muscle protection.

Specific collagen supplementation regimens offer a unique value proposition in sports nutrition products. Collagen supplementation might not only play a role in treatment of injury and OA but may also play a role in prevention of injury, therefore supporting bone and joint health of a young and active population and helping them stay active throughout their lifetime. ●



*Professor Robert Hickner is the Linda Grizzard Owens Professor for the Department of Nutrition, Food and Exercise Sciences, and Associate Dean of the College of Human Sciences at Florida State University. His research interests are broad and involve investigating how exercise and nutrition impact on the regulation metabolism and blood flow in peripheral tissues to improve cardio-metabolic disease risk across the lifespan. He is also a multi-sport athlete and has competed in many triathlons including the Hawaii Ironman World Championship.*

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### Findings to be presented at Vitafoods Europe

At the Sports Nutrition Theatre at Vitafoods Europe this May, as PB Leiner's guest speaker, Prof. Robert Hickner will discuss the effectiveness of collagen supplementation and the potential benefits of collagen for reducing inflammation and joint pain, as well as improving joint health and physical performance in athletic and non-athletic populations. The session will cover most of the significant research in the field that is not industry funded by industry, while also giving insights into recommended collagen peptides dosages.



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# Bone and joint support for athletes

Collagen as a solution for stronger tendons and ligaments

By Suzane Leser

**Leading market** reports named collagen the 'hottest ingredient' of 2018, and collagen is now gaining traction in the sports nutrition arena, where research is positioning collagen peptides amongst the top sought-after supplements for athletes.

## It's collagen's time

There is more to protein than amino acid building blocks. A new understanding of peptide activity is emerging, taking protein nutrition to functional level, where the role of protein has become more than just providing the amino acid building blocks. Studies are showing how certain collagen peptides can signal cells to make new connective tissue proteins for stronger ligaments and tendons – thereby reducing the risk of overuse injuries in sports and everyday life. Muscles do not exist on their own and the vital role of the connective tissue is gaining attention in sports.

Every sport requires a degree of strength, power and speed, relying heavily on tendons and on the intact composition of their extracellular matrix proteins. Overuse makes tendons and ligaments more injury prone, so it is no surprise that soft tissue injuries are extremely common in both amateur and professional sports. Injuries today account for more than 70% of time away from sports, with personal and financial consequences to the sportsperson, showing that there is a real need for nutritional strategies to strengthen the connective tissue.

## Investigation

A new specialty collagen peptide (TENDOFORTE®, from GELITA) was recently developed specifically to strengthen tendons and ligaments, and two clinical studies demonstrated its ability to reduce the incidence of sports injuries and accelerate return-to-play.

The first study, conducted by the Australian Institute of Sport (AIS), showed that subjects with long-term symptoms of chronic Achilles tendinopathy, who had not responded to any of the conventional rehabilitation methods, were able to return to running within three months when supplementing with 5 g/d of TENDOFORTE and were able to keep running for the remainder of the six-month trial period.<sup>1</sup>

A second study, conducted by the University of Freiburg Department of Sport, in Germany, looked at the effects of TENDOFORTE® in reducing ankle sprains and improved ankle stability.



Ankle sprains are one of the most widely spread injuries in sports, leading 30 to 40% of athletes to suffer from permanent impairments. Six months supplementation at 5 g/d resulted in significant improvements in ankle stability, reduced ankle sprains, and reduced re-injury rate in the three-month follow-up period, suggesting that the effects were long-term, promoting the natural healing process.<sup>2</sup>

In addition to proven clinical efficacy, GELITA's Bioactive Collagen Peptides®, including TENDOFORTE, can work in synergy with a wide variety of other ingredients, exhibiting no negative nutrient-drug or nutrient-nutrient interactions, no history of adverse events in clinical studies, and no allergenicity. In addition, the 5 g dosage can be easily incorporated in a range of final products such as bars, drinks and powders with no texture or sensory impact—key for athletes' compliance as well as for increased frequency of purchase for the final product. These natural proteins have a neutral odour and taste, clean label, and excellent solubility making them suitable for clear solutions. ●

*Suzane Leser is director of nutrition communication, business unit health & nutrition, at GELITA.*

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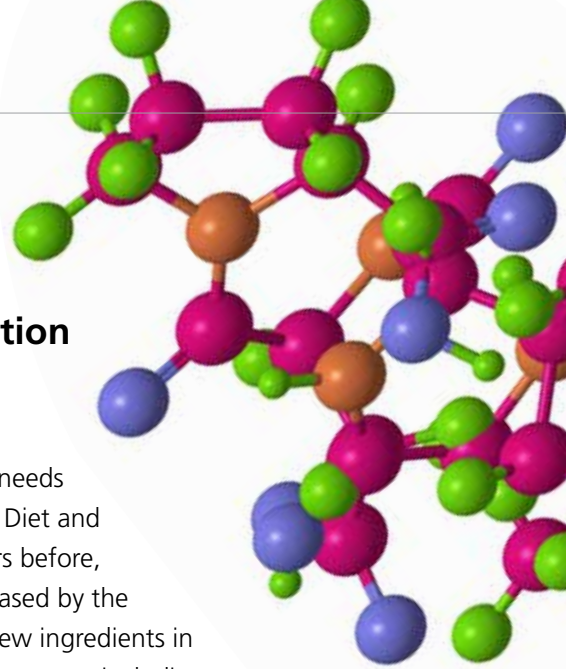
## GELITA at Vitafoods Europe

Exhibiting at this year's Vitafoods Europe (stand E14), GELITA will showcase its latest innovation in sports nutrition. The company's experts will also be presenting at the Life Stages Theatre, Tuesday 7 May: "Ageless with Bioactive Collagen Peptides® – new perspectives on bone and skin health" presented by Dr Stephan Hausmanns, vice president for the business unit health and nutrition. In the Sports Nutrition Theatre, also on Tuesday 7 May, GELITA will be presenting: 'TENDOFORTE® – the first collagen solution for stronger connective tissue in sports and exercise' by Suzane Leser, director of nutrition communication.

# Peptide power

## Case study of AI-identified plant-based peptide to address sports-related inflammation

by Dr. Dietrich Rein and Mareike Kampmann



**N**utrition in sports plays an important role in meeting consumer needs associated with physical performance, exercise stress and recovery. Diet and supplementation have been positioned to support active consumers before, during and after a workout. In a consensus statement recently released by the International Olympic Committee, the conclusion was that only a few ingredients in existing dietary supplements have good evidence to enhance performance, including creatine, some buffering agents, nitrate and caffeine. Physical exercise stress is well known to stimulate inflammatory processes. Inflammation is a natural and necessary response to exercise-induced muscle damage, primarily to facilitate tissue regeneration. However, recommendations given by sports nutrition in addressing physical recovery are only just emerging.

### What is a peptide?

Peptides are short amino acid chains either derived from protein breakdown (hydrolysis), mainly an enzymatic process, or synthesised specifically for their biological function. In human nutrition, peptides serve three functionalities:

- as an easily accessible source of amino acids,
- as a hypoallergenic source of proteins, and
- as biologically active peptides.

Peptides in general play an important role in human health by affecting digestive, endocrine, cardiovascular, immune and nervous systems. However, our body protects itself from dietary peptides by breaking down most of them. Still, nutritional peptides have been shown functionality—namely collagen peptides to reduce activity related joint pain and stimulate extracellular matrix synthesis, milk peptides to reduce blood pressure, or egg peptides to modulate immunity.



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### Active consumers demand plant-based health solutions

An increasing number of consumers around the globe are leading more active lifestyles and taking on greater responsibility for their health. To support themselves in their endeavours, they are looking for trustworthy plant-based products. Inflammation, often perceived as pain, is a key concern of active people. It often starts with a feeling of discomfort that might turn into minor pain. It can also occur in a feeling of stiffness and soreness, preventing active people from increasing or maintaining their physical activity. In a consumer research project, consumers were asked about the frequency of their physical activity; 69 percent of respondents indicated that they engaged in physical activities more than three times a week. Of these respondents, 62 percent agreed that recovery is a critical aspect of their post-workout plan and 67 percent of those polled would consume a dietary supplement to aid post-workout recovery. When asked what their preferred product of choice would be, they revealed that a sports bar containing plant-based peptides, delivering the benefits of managing inflammatory response to their body would be an ideal solution.

#### CASE STUDY:

#### Artificial intelligence-enabled discovery of immune active peptides for sports nutrition

Artificial intelligence (AI) is an area of computer science which applies self-learning algorithms to emulate human-like thinking, featuring high speed, pattern recognition and pattern recall. Nuritas, a partner of BASF, adapted this technology by developing and training algorithms using information on biological networks and active molecules in order to build accurate predictors of biological activity. Precise queries for peptides affecting inflammatory processes were designed. First steps started with a detailed landscape based on existing data drawn from the globally accessible scientific knowledge, followed by human curation. Following on, available food proteins were data-mined for the presence of the active peptides and yielded brown rice as the most potent source material. AI was then utilised to identify four peptides with potential for biological activity. A food-process to commercial scale was further developed by liberating a fraction of the bioactive peptides into the protein hydrolysate. As a result of this work, a powder product, dubbed PeptAlde™ by BASF, was created. Its physiological relevance still has to be verified in silico, characterised in cell culture and tested on volunteers.



### Emerging science supporting product development

Exercise-induced muscle damage stimulates important inflammation markers including cytokines interleukin (IL)-6 and IL-10, and C-reactive protein (CRP). IL-6 increases rapidly during exercise whereas CRP responds much slower. Although the precise biological action of muscle-derived cytokines is still uncertain, IL-6 released from contracting muscle is important in regeneration and has both, pro- and anti-inflammatory functionality. The peptide powder offers itself as a plant-based protein hydrolysate containing a set of peptides that specifically help modulate inflammation. To verify the biological significance, the interaction of AI-identified peptides with IL-6, the Tumor Necrosis Factor- $\alpha$  receptor and IL-10, was shown in silico to reveal relevant results in physical recovery. Two standardised cell culture systems further confirmed the potential of the peptides. The first included stimulated immune active macrophage cultures, and the second applied primary human fibroblasts that synthesise extra cellular matrix and collagen. Finally, a single dose of the powder was assessed in healthy volunteers, which was considered to be well-accepted. The product transiently affected selected immune and inflammation markers assessed in blood plasma. Interpretation of the initial results confirmed beneficial effects towards the support of muscle stress response. ●

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## Takeaways for your business

**Sustainability concerns and knowledge** of health benefits have driven demand for plant-based solutions over the past decade. New advances in taste, texture and formulation have helped to accelerate products to the consumer market, and now plant protein is infiltrating the sports nutrition market—catering to amateur and professional athletes. Not only do plant-based ingredients provide athletes with an alternative protein source, but they also offer health benefits geared toward performance and endurance.

A primary challenge for the plant protein market is lack of all essential amino acids in finished products, and anti-nutrients which compromise bioavailability. As plant-based foods grow in popularity, sufficient protein and nutrition levels are a top priority. Plant foods typically contain substantially lower total protein content per serving than animal-based foods. Products that can join soy as a 'complete' protein and have fewer anti-nutrients will rise to the top.

Soy-based products continue to dominate the market, appreciated for its amino acid and high digestibility scores. Rice and pea protein are popular alternatives, with pulses (part of the legume family), seeds and algae also entering the space. Different plant sources offer different micronutrients, but sports nutrition manufacturers need to prioritise creatine, omega-3 fatty acids, iron, calcium, zinc and vitamin D as key properties for product development.

Consumers will continue to shift toward flexitarian, vegetarian and vegan diets as concern for health and the environment rises. Coupled with a rising population of active consumers, the sports nutrition sector is forecast to grow in its plant-based offerings over the coming years.

An understanding of the different plant ingredients' health benefits and micronutrient offerings is essential for companies looking to develop plant-based products for the sports nutrition market. Beyond health, consumers are also looking for plant products that deliver on taste. Companies that manage to deliver on taste and nutrition will win the competition for shelf space in retail stores.

Although typically developed for the bone and joint health sector, the development of collagen in sports nutrition products is growing as manufacturers close the gap between these two markets. Learnings taken away from clinical studies suggest that orally-administered collagen peptides may have beneficial effects for athletes by increasing bone mineral density and physical strength of the bones as well as alleviating pain, maintaining mobility and minimising disability of the joints. In joints, collagen peptides can protect and rebuild cartilage and ligaments, resulting in improved mobility as well as reduced stiffness and pain that may result from tissue damage and swelling of the joints.

Existing bone and joint health manufacturers, as well as newcomers to the market, have the opportunity to differentiate their offering by developing collagen products specifically for the sports nutrition market. ●

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