



Excellion®

Caseinates - our ingredients, your building blocks



FrieslandCampina air
Ingredients



Casein Proteins – A Brief Introduction

This brochure will give you a comprehensive overview of casein protein, including the versatility of casein and how its functional and nutritional properties make it the ideal ingredient for the performance nutrition market.

What is casein protein?

Casein proteins, in their native form of casein micelles, account for about 80% of the total protein found in cow's milk¹. Whey proteins make up the other milk protein fraction (20%). However, casein and whey proteins have distinct physical-chemical properties. Most striking is the lack of a globular structure for casein proteins, explaining their high-heat stability.

One crucial difference is that casein proteins are not acid soluble and will therefore precipitate in acidic conditions.² These properties are the basis for their separation during the refinery process, resulting in caseinates. Conversely, whey proteins are not heat stable and will aggregate and gel upon heat treatment³, limiting their use in ambient-stable, high protein Ready-to-drink (RTD) applications, for example.

Extracting casein protein

Using milk as a starting point, there are three ways to separate its two main protein fractions, leveraging the different physical-chemical properties of casein and whey proteins. This can be achieved via renneting (cheese-making process), acidification (caseinate process) or filtration (micellar casein isolate process).⁴ In renneting and filtration, the micellar structure of casein is kept intact whereas caseinate manufacturing has an extra acidification step, which causes the casein micelles to separate into their natural protein building blocks: caseinates.

Nutritional value of a casein protein

Casein protein is a high-quality protein, which means it contains all nine essential amino acids needed to make proteins found in the human body.⁵ Essential amino acids (EAAs), also known as indispensable amino acids, cannot be synthesised from metabolic intermediates by humans and other vertebrates. These amino acids must therefore be supplied from an exogenous diet.⁶

For muscle protein synthesis to occur, sufficient levels of all EAAs must be present. When one essential amino acid is limited or not available, new tissue cannot be completely built, as depicted by the Liebig barrel diagram (figure 1).

Processing and storage can also impact the bioavailability of essential amino acids, particularly lysine. In fact, some high-protein products available today experience protein glycation during processing and storage, which is the first step of what's known as the Maillard reaction.⁷ This impacts the availability of essential amino acids, such as lysine, for protein synthesis – an important factor in many nutritional products aimed at muscle development and maintenance.^{8,9,10} Thanks to the low lactose content of FrieslandCampina Ingredients' Excellion® range of caseinates, the risk for glycation is low.

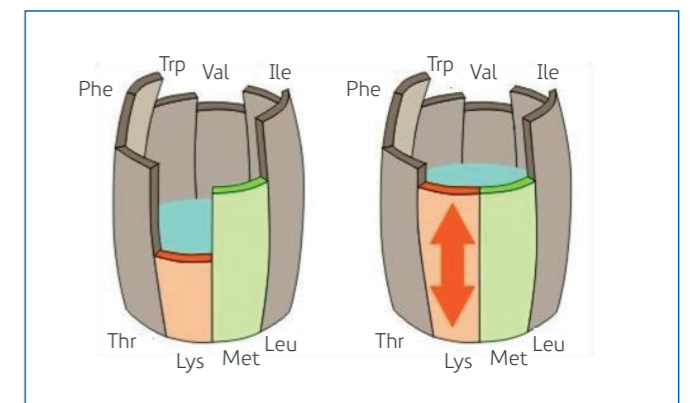


Figure 1: Liebig barrel demonstrating how sufficient levels of all EAAs must be present to build muscle.

Why use casein proteins in performance nutrition?

In sports nutrition, there are many protein sources and blends for consumers to choose from, each providing unique benefits, such as enhanced recovery, increased muscle mass and improved muscle strength. The performance nutrition market is mainly dominated by whey protein: a protein source that increases muscle protein synthesis more than soy or casein protein.¹¹

Casein protein has its own benefits; it is a high-quality protein source, with a unique digestion profile and mineral binding ability.

Digestion speed of casein: benefitting consumers night and day

Casein and whey protein have distinct anabolic properties, which are attributed to differences in digestion. Whey protein is a soluble protein, leading to fast intestinal absorption. Casein on the other hand, clots in the stomach due to the acidic environment, which results in delayed gastric emptying [figure 2].^{12,13}

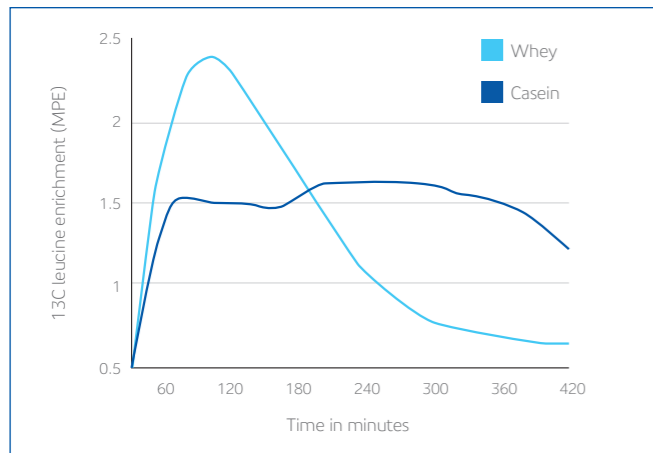


Figure 2: Whey protein is absorbed more quickly than casein.

Whey protein is known as an easily digested, high-quality protein source, while casein protein is considered a high-quality, bioavailable protein source, with a sustained amino acid release profile^{14,15}

In recent years, there has been growing interest in protein sources with a sustained release of amino acids. Casein protein, for example, has been linked to overnight recovery. With the right nutrition strategy, it is possible to extend muscle recovery during the night to maintain muscle mass. Figure 3 clearly shows the decrease of muscle protein synthesis during sleep, while muscle protein breakdown appears to be stable: a period called the 'protein feeding opportunity'.¹⁶

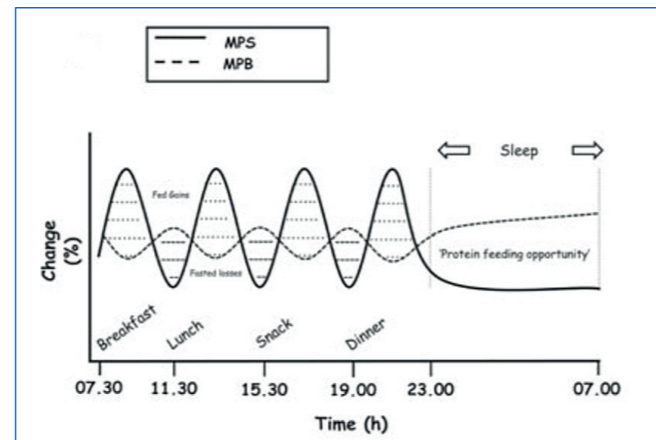


Figure 3: Schematic overview of muscle protein synthesis (MPS) and muscle protein breakdown during the day (MPB).¹⁶

Studies show that protein ingested before sleep is properly digested and absorbed, resulting in muscle protein accretion overnight.^{17,18} When athletes were provided with a single dose of 40 grams of casein protein prior to sleep, muscle protein synthesis was significantly higher (about 22%) compared to the placebo drink as seen in figure 4.¹⁹ This highlights the opportunity to better use the overnight recovery period.

More recently, studies show that the sustained release of amino acids enables muscle synthesis to be stimulated for an extended period during the day.²¹ This study, performed in healthy young individuals following exercise, showed that consuming large doses of a protein powder containing 80% casein (and 20% whey) could stimulate protein synthesis rates for at least 12 hours after ingestion. This was surprising, since ingesting more than 25 grams of protein resulted in a greater stimulation of protein synthesis rates, and for a longer period than was previously believed.²²

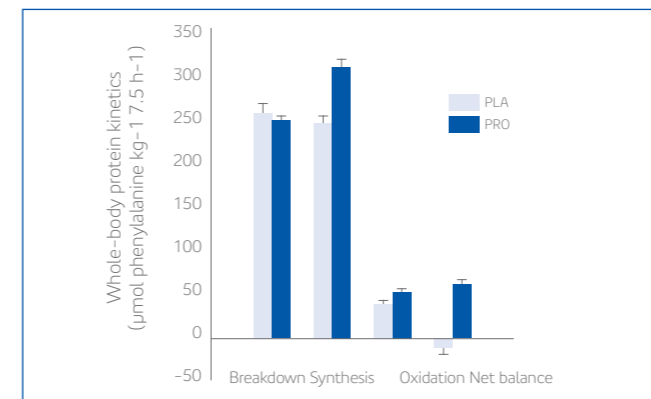


Figure 4: Rate of whole body protein breakdown, synthesis and oxidation rate and net protein balance in the protein (PRO) and placebo (PLA) experiments measured during 7.5 h of overnight recovery.¹⁹

Previous studies also highlighted the benefits of consuming casein proteins separately or in combination with whey protein on fat-free mass, after multiple weeks of resistance training and supplemental protein ingestion.^{24,25} The outcome of these studies may be due, in part, to the combined availability of amino acids released in a more sustained manner from protein compared to only whey protein.

Interestingly, ingestion of a calcium caseinate protein, combined with several weeks of endurance training, has also been shown to significantly increase exercise capacity and reduce overall body fat mass.²⁶

FrieslandCampina Ingredients has the experience and knowledge, backed by science, to help our customers deliver tailored communications and applications with micellar casein and caseinates, to meet consumers' evolving needs.



FrieslandCampina Ingredients: a caseinates powerhouse

FrieslandCampina Ingredients is proud to be a leading caseinates producer, supplying Excellion® to the global nutrition industry. Our Excellion® caseinates range enables you to provide high-quality proteins and essential amino acids in a range of formats – from bars to Ready-to-drink (RTD) and Ready-to-mix (RTM). With a vast product portfolio, we focus on innovation and nutritional research of casein protein, to unleash its unique power.

High protein bars

Whether it's for athletic recovery, a quick snack or something to keep you going until the next meal, high-protein bars continue to grow in popularity. They are also an easy way to get nutrients and energy in a convenient format on the go.

A recent study showed that consuming a high protein bar containing FrieslandCampina Ingredients' solutions triggered a plasma amino acid response that mirrored the results obtained from drinking a high protein shake with identical properties.²⁷

There can be challenges when formulating high-protein bars, such as ensuring the dough structure has a good taste, texture and mouthfeel, while avoiding hardening of the bars during shelf life, all while maintaining low sugar content.

FrieslandCampina Ingredients offers a range of bar solutions tailored to match your consumers' needs. Excellion® EM9 and Excellion® Textpro reduces the stickiness, hardness and dryness of high protein bars, while improving bite and chew. Both ingredients are easy to formulate with other proteins in our portfolio.



Ready-to-mix

Popular for their easy-to-use format, high-protein Ready-to-mix are still dominating the performance nutrition market. Here, protein sources can easily represent 50% to 99% of the total powder formulation as single ingredients or as a blend of different protein types. Therefore, the sensory profile and quality of the protein source will strongly influence the end application characteristics – and possible consumer acceptance.

As more consumers discover the performance and active nutrition market, taste is becoming increasingly important. Developing a successful high-protein shake today not only requires a good nutritional profile, but even more importantly, it must deliver excellent taste, along with good dispersibility and solubility of the powder.

FrieslandCampina Ingredients offers Excellion® Calcium Caseinate I, an ideal powdered ingredient in high-protein shakes, thanks to its excellent neutral taste, milky appearance, pleasant mouthfeel, high nutritional profile and fast dispersibility. It provides consumers with a rich and appealing shake.



Ready-to drink (RTD)

Consumer demand for protein drinks is still on the rise, but there is still plenty of opportunity to create better tasting on-the-go formats, with a superior nutritional composition.²⁸ A high-protein RTD beverage should be carefully formulated to meet these evolving needs. With a protein content ranging between 5 to 12%, RTDs are heat-treated to guarantee a shelf life of up to 12 months, ensuring freshness and convenience, without compromise.

Excellion® Calcium Caseinate S makes great-tasting, stable UHT drinks, since it is very heat stable and does not denature, aggregate or flocculate during heat treatments. It also provides a milky appearance in end applications. Designed to offer low sediment during shelf life, it also reduces chance of spoilage due to a very strict microbiological specification. Thanks to its neutral taste profile, Excellion® Calcium Caseinate S enables ultimate flavour flexibility.



Yoghurt

A high-protein yoghurt contains approximately 15 to 20 grams of protein per serving: much more than the 6 to 8 grams usually found in traditional yoghurt. High-protein yoghurts not only support muscle growth and recovery, but also helps consumers feel fuller for longer. Caseinates are ideal for formulating in yoghurt and other fermented products. Adding a limited percentage of caseinates to milk prior to fermentation greatly enhances the firmness

of set yoghurt and the viscosity of stirred yoghurt. The combination of caseinates and selected whey proteins also enables you to tailor the smoothness, thickness and shine of yoghurt products.

Excellion® Calcium Caseinate S provides a pleasant mouthfeel which is smoother and less 'dry' compared to other milk proteins or regular (strained) Greek-style yoghurts. Plus, it creates viscosity and creaminess in stirred yoghurt, while providing good firmness in set yoghurt.



FrieslandCampina Ingredients

At FrieslandCampina, we are proud to have more than 150 years of milk processing heritage. Milk from our own dairy farms is processed into a variety of fresh products but it also contains other valuable components, such as caseinate, which is used as an ingredient in many applications. As a dairy co-operative, we have a unique opportunity to control the complete value chain, 'from grass-to-glass', ensuring the highest level of quality and sustainability for our customers across the globe.

Let's connect

For more information, please visit our website or contact your FrieslandCampina Ingredients representative.

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