

## *The evolution of the protein value chain – Sustainable protein systems for a growing world*

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As the world's population is on course to surpass ten billion by 2050, our food systems face the challenge of providing sustainable nutrition without further harming the planet. Animal-based diets and the reliance on animal-derived proteins are significant contributors to environmental degradation and public health issues. Not only is the global population increasing, but the expanding middle class in developing nations is driving a surge in protein demand, intensifying the strain on our environment. Animal proteins are a principal factor in climate change, biodiversity loss, and the draining of freshwater resources, with the agricultural food sector responsible for approximately 25% of all greenhouse gas emissions. To address these issues, we must diversify protein sources and reduce food loss and waste, ensuring that alternatives are not only accessible, but also desirable to consumers.

Over the past five years, the protein value chain has undergone significant transformation with plant-based proteins rising in popularity and consumer acceptance. Despite this progress, formidable challenges remain to further advance the industry. The food industry is tasked with designing more efficient processes that use less energy and water to extract and purify plant-based proteins. Additionally, there is an urgent need for a new wave of protein concentrates and isolates to support specific market demands. This includes the development of specific fractionation processes crucial for preserving or enhancing protein functionalities for use in plant-based foods, where taste profiles and textural properties are vital for consumer acceptance.

Bühler's state-of-the-art Application Centers are hubs where research is conducted to enhance the protein value chain through advanced technologies. The transformation begins at the Grain Innovation Center, where raw materials such as pulses or grains undergo cleaning, de-hulling, and dry grinding, before being purified in process steps like dry fractionation.

Dry fractionation, which capitalizes on physical properties to separate protein-rich from starch-rich fractions, is an eco-friendly method due to its low energy requirements and lack of wastewater generation. The starch-rich fractions, or side streams, from pulses or grains can be used in products including snack bars, baked goods, pasta, or pet food, thus, supporting the concept of a circular economy. By contrast, wet fractionation processes are employed to achieve high-purity protein concentrates or isolates that are vital for their versatility in the food industry. The Protein Application Center is dedicated to wet fractionation processing, beginning with wet grinding and/or dispersion to initiate protein purification.

In addition to well-known methods like solid-liquid separation and isoelectric precipitation using decanter centrifuges, the Protein Application Center provides the advanced option of using

membrane filtration technology. Beyond purification, the membrane system fosters the development of sophisticated methods, such as the separation and purification of specific protein fractions, to customize the techno-functional properties of protein ingredients. After extraction, protein powders are produced using drying technologies such as spray drying to ensure stability. This is where the unique advantage of the Bühler Application Centers comes into play. If the protein obtained in the Protein Application Center is to be used in an extrusion process, the energy-intensive spray-drying process can be suspended and the purified protein slurry can be dosed directly into the extruder next door.

Those described integrated approaches also include comprehensive application testing – ranging from meat analogs utilizing extrusion techniques to plant-based beverages and dairy alternatives – to guarantee that these plant-based proteins meet, and often exceed, market standards for taste, texture, and nutritional value. Through ongoing innovation and collaboration, Bühler is committed to scaling up sustainable protein production to meet the global demand while caring for our planet.