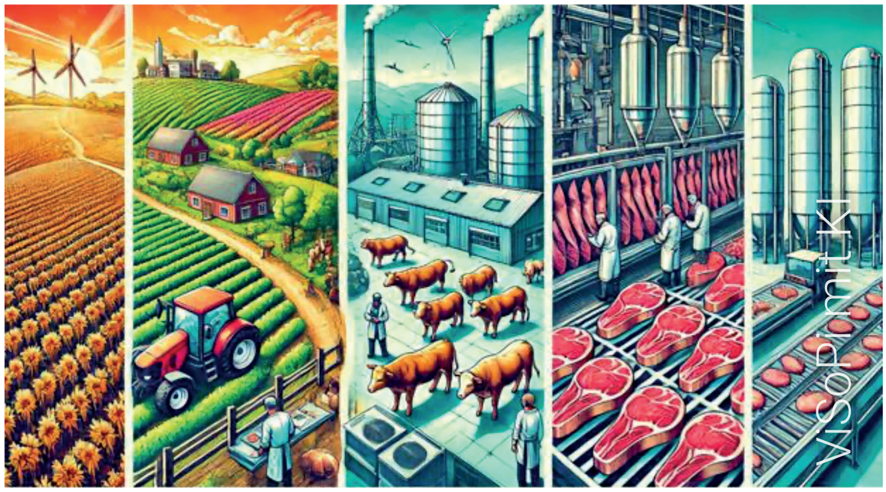
SUSTAINABLE PLANT PROTEIN INGREDIENTS

By Henk Hoogenkamp - Author & Protein Technology Expert



All protein starts with plants. Protein is the only macronutrient that has not been demonized. On the contrary, people living in developed and affluent countries can't seem to get enough of it. Yet, society should not close its eyes to climate change, especially extreme weather and rapid population growth, which is intensifying pressure on traditional protein sources, making the search for innovative alternative proteins imperative for global protein security and resilience. An ideal dietary intake will require diversified animal- and plant-based sources, providing high-quality nutritive values and sensory experiences.

Over the last few years, the value of protein ingredients has shifted and now includes premium plant proteins such as those sourced from soy, pea, oat, and rice. Plant-formulated food and plant meat products can be considered part of a broader dimension of smart protein choices replicating the organoleptic and cultural resonance of traditional meat, milk, and eggs. These global smart protein choices are mainly sustainable ingredients that align planetary health, dietary health, and economically sensible food security.

It will be difficult for the alternative protein ingredient market to continue its transitional growth without diversifying and embracing the values and availability of animal-derived protein sources such as meat, eggs, and dairy, which maintain or improve the sustainability and health of plants and people.

In the world of plant protein, soybeans will keep their number one spot for affordable, sustainable, traceable protein, as well as important oil and energy sources. The versatile soy crop is well-placed to address global issues such as inflation, pushing consumers to select cheaper protein options. Besides the soy protein and soy oil components for human consumption, soybean meal is the most convenient feed, which is especially important for the rapidly growing consumption of pork and chicken meat production.

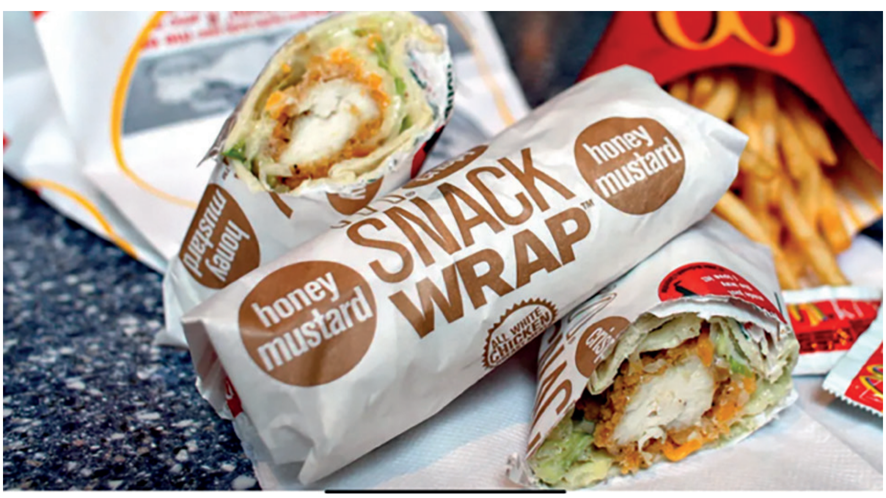
Sustainable food production growth needs to be increasingly referenced to ecological and economic development and permanently implemented without limiting natural resources and endangering the health and wellbeing of future generations. The booming interest in plant protein nutrition is driven both by changes in socio-economic lifestyles and a deepening awareness of the importance of health, wellness, and sustainability. The "flexitarian consumer," not the vegan consumer, is the driving force behind the growth of plant-based food choices. There is little doubt that plant-based protein consumption is a consumer-driven shift that details a landscape of health concerns, as well as ethical and environmental considerations. However, it is important to know that no protein source is inherently "sustainable" or "unsustainable." There are simply too many variables at play and trade-offs within the many production systems when assessing the ecological and environmental impact of plant-based protein alternatives versus animal-based protein choices.

A more nuanced understanding is necessary when discussing the interconnections between the various protein choices: one source is not necessarily more sustainable than the other, especially when over-reliance on a limited number of crops is part of the equation. Issues such as water scarcity or flooding and disasters like deforestation and biodiversity loss always come to mind. Therefore, it is important to not only assess and analyze full value chain needs in a broad setting of variables like soil depletion, food waste minimization, and source diversification but also apply innovative systems like upcycling and regenerative agricultural practices.

Regenerative agriculture is integral to the fight against climate change and biodiversity loss, requiring multiple stakeholder alignments and value chain reconfiguration. For example, the transition to regeneratively grown and spent barley is well on its way and will become part of the collective endeavor for beer brewers to reduce carbon by recovering valuable upcycled protein that makes the food system more sustainable. Farmers will be the focal point to kickstart regenerative agricultural missions to ultimately accomplish a 100 percent success rate. Specifically, it is important to change the farmers' mindset by considering longer-term soil health instead of short-term crop yield.

Nuances are Key

Usually, the outcome is that the protein supply chain is devoid of a black and white answer. Nuances and balanced interpretation should be at the forefront of the supply chain decision-making process. In a world without animals raised for meat consumption, many food side streams would go to waste and huge parts of marginal lands would no longer be productive. As such, the food industry needs to foster a well-balanced relationship between the various animal and plant protein groups that come with a guarantee of responsibly-sourced protein components on an ethically sound, economical, and healthy scale. Some global consumer patterns are shifting towards replacing—for example—soy protein or animal-based proteins from their dietary intake. These patterns flourish because of consumer interest in ecological sustainability, health, and ethics, all related to the broader consumer lifestyle in affluent societies towards greener living.

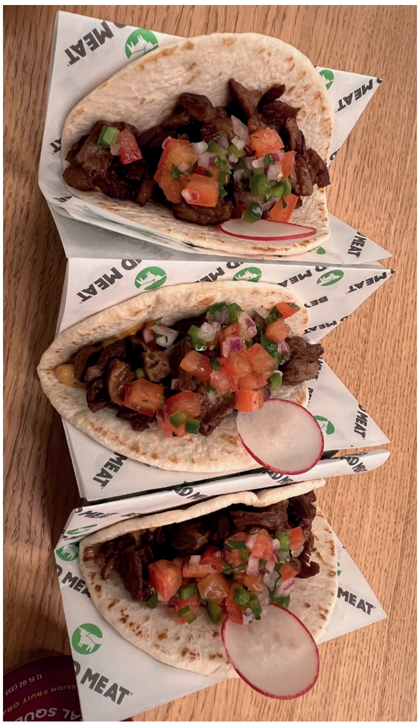


The plant-based protein (r) evolution shows no signs of stopping anytime soon. Plant-based meat and plant milk can be sustainable, tasty, healthy, and ultimately affordable for the masses. Consumers want to have better food choices, though this transformative restructuring of the diet usually needs to be implemented on a longer pathway yet allows them to continue to eat what they are accustomed to. A consumer-centric approach will therefore be essential to track evolving trend changes.

Novel Dry & Wet Proteins

Globally, the demand for high-quality nutritional protein is expected to rise by 70 percent over the next 30 years to nourish the growing population. Beyond soy and pea protein ingredients, alternative protein sources are also gaining momentum with a growing number of ingredients made from rice, oat, barley, mycoprotein, algae, as well as precision fermented "vegan" cow-free milk protein and egg-free albumen protein ingredients.

The introduction of novel or niche protein ingredients like those derived from algae, rapeseed (canola), hemp, fava, chickpea, mung bean, barley, lupin, rubisco, sorghum, and potato, is a long and difficult road to navigate. It takes extraordinary effort and many years of hard work to convince R&D to change a proven formula. This is especially true for sensory and technological acceptability, labeling, and health issues. For example, companies like Roquette, Cosucra, and Avebe struggled for many years to get



pea protein and potato protein ingredients on the radar screen of food formulators. After many years of dedicated work, they finally succeeded, although it is true to say that part of their success is because of certain negative consumer image issues around soy protein.

Despite the rapid global growth of plant protein options, the organoleptic, functional, and even sustainability challenges continue to hold the plant protein market back. The main ecological drawbacks of most plant protein ingredients are heavy energy use and water consumption, negative-sounding chemical use such as hydrochloric acid (HCL), and enzymatic treatment to not only separate starches and fibers but also cleave off or modify proteins and peptides. These plant-based protein ingredients also require intense centrifugal energy for the separation steps, often followed by more enzymatic treatment in fermentation tanks, and finally spraying or drum drying.

It is therefore essential that innovative technology systems be engineered to significantly reduce or eliminate ecologically damaging influences such as excess water, chemicals, and energy waste. Dry- and wet fractioning, as well as possibly cavitation technology, are promising developments that may offer solutions for true sustainability.

Pulses like yellow pea, fava beans, chickpeas, and mung beans are trending due to their natural protein content and the relative ease, i.e., climate considerations, to cultivate these plants in most agricultural regions in the world. Another major advantage is the ability to extract these plant proteins using both dry and “wet fractioning” while removing substances that would otherwise inhibit the digestion of the protein and components that negatively affect flavor, color, and odor while maintaining good texture, including popular extruded varieties.

Fava is a globally grown GMO-free crop that needs limited water use and is known for its efficient nitrogen fixation. Fava protein isolate is an emerging ingredient that is highly stable in solutions providing excellent binding or emulsification properties.

Fava beans and chickpeas have been around for many years and served as substitute sources for soy. Recently, fava beans and chickpeas have received renewed interest as valuable nutritional allies for plant-based formulations. These vegan protein options bring texture and juiciness to a wide range of applications, including mayonnaise, falafels, snacks, and dips such as hummus.

When used in extrusion for plant or hybrid meat applications, fava protein isolate demonstrates certain characteristics that cannot be delivered by soy or pea protein-formulated products. One of the recently introduced fava protein ingredients is the Tendra brand by Royal Cosun, Netherlands.

Flavor Is Key

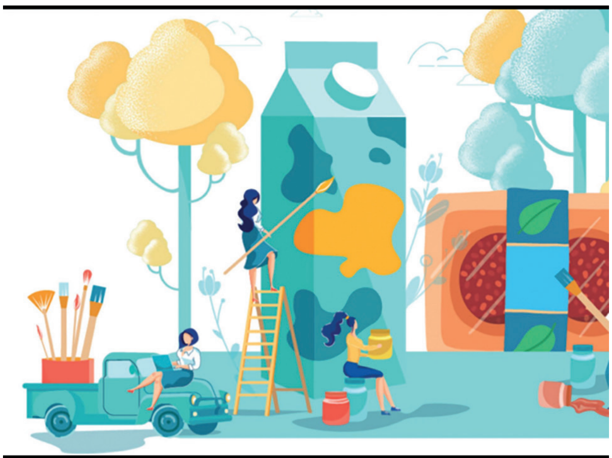
There are typically flavor, taste, and processing issues with higher inclusion levels for plant protein ingredients, rendering the final food or beverage product less attractive to the consumer. Food formulators are often trying to reach a certain inclusion level of “x grams of protein per serving.” In many cases, the downside includes issues and challenges such as taste, less dynamic functionality, or processing limitations like salt sensitivity. To improve consumer acceptability, food formulators sometimes pull back on inclusion levels and/or need to add masking agents like autolyzed yeasts, synthetic sweeteners, and flavor conditioners. The latter may be difficult if a clean and natural label is important, although recently new "sugar-free sweeteners" have been introduced.

Compared to traditional animal protein choices such as dairy protein and egg albumen, limitations and physicochemical constraints of plant protein ingredients often cause difficulties in meeting the functional and organoleptic properties, such as taste, texture, appearance, as well as gelation or emulsification properties. For food formulators, it is a major challenge to create certain plant-based foods such as plant-formulated mozzarella for pizzas and vegan ice cream with the same qualities as meltability and creaminess that make animal-protein based foods superior.

More Than Soy

The plant protein category encompasses more than just soy. Innovative new protein sources are a welcome addition to the plant protein portfolio. Choices of soy-free plant protein ingredients may have sought-after benefits like flavor, hypoallergenicity, gluten-free, immunological characteristics, positive name association, and preferred "clean and natural" labeling. A few of these plant protein ingredients aim to replace soy and dairy protein. This makes sense considering that soy protein and dairy protein are still the world's largest and most dominant proteins.

The demarcation lines between the various protein sources like those extracted from soy, pea, rice, hemp, oat, barley, canola, potato, and dairy are disappearing. Segmentation and market positioning of these functional and nutritive ingredients will determine which will most likely succeed or be used as an alternative back-up source, also termed the "most likely alternative" when possible alternative formulas are developed.



Inclusion Choices

Plant proteins hold great potential for dry-blended beverages, breakfast cereals, nutri-bar fortification, and meat alternative products, including high moisture extrusion for foods that uniquely duplicate meat and fish equivalents. In organoleptic terms, high inclusion levels of plant protein ingredients for taste, color, and texture remain challenging. When cooked or extruded at high temperatures, undesirable darker colors (Maillard reaction) may be formed, together with beany and nutty tastes, while losing some essential amino acids like lysine. Higher inclusion levels of plant protein also create a harder texture and higher density. A blend of multiple protein types such as protein sources derived from soy, pea, rice, fava, barley, mung bean, chickpea, and lentils can be considered.

In developed countries, allergies are on the rise and soy protein is especially hard hit. Moreover, phytoestrogen class chemicals (isoflavones) are also found in relatively high levels in soy isolate-formulated products (100mg/kg). In comparison, pea protein isolate has typical levels of <3mg/kg, which is nearly undetectable. Another potential downside of some plant protein ingredients are the anti-nutritional factors that may greatly reduce the intrinsic nutritional value. It is, therefore, important to design protein-processing systems that allow the removal of anti-nutritional factors. An example is the inactivation of trypsin in soy protein.

Emerging Plant Issues

A possible emerging negative side effect of purified plant protein production is the side stream of components such as hulls, fibers, and carbohydrates. Especially water-insoluble fiber fractions are difficult to sell and usually generate weak revenues. It is important to find an outlet for the side stream components, as some of the plant components are not economically viable.

The FDA Endorsement

The FDA has been promoting pulses such as chickpeas, lentils, peas, and beans as a sustainable and environmentally-friendly food source. Some of the current plant farming methods are degrading soil at a much faster speed than nature can replenish. Soil erosion is a slow but continuous process if not handled with care, with drought and poor farming practices further aggravating the erosion. Failure to manage natural resources, including top-soil erosion, may ultimately cause food insecurity by supply chain interruption and liability risks.

Climate change and the use of synthetic fertilizers will not bode well for maintaining topsoil organic matter. Farming systems need to have both strong resilience and a strong adaptive sustainable capacity. Crop rotation, intercropping, "green manure," and recycling biomass are some of the practical solutions available to better deal with the challenges of a changing climate. Sustainable soil management and pulses work well in tandem because of the presence of soil bacteria, which act as natural nitrogen fixers and foster soil carbon sequestration. This combination considerably allows the reduction of synthetic nitrogen.