

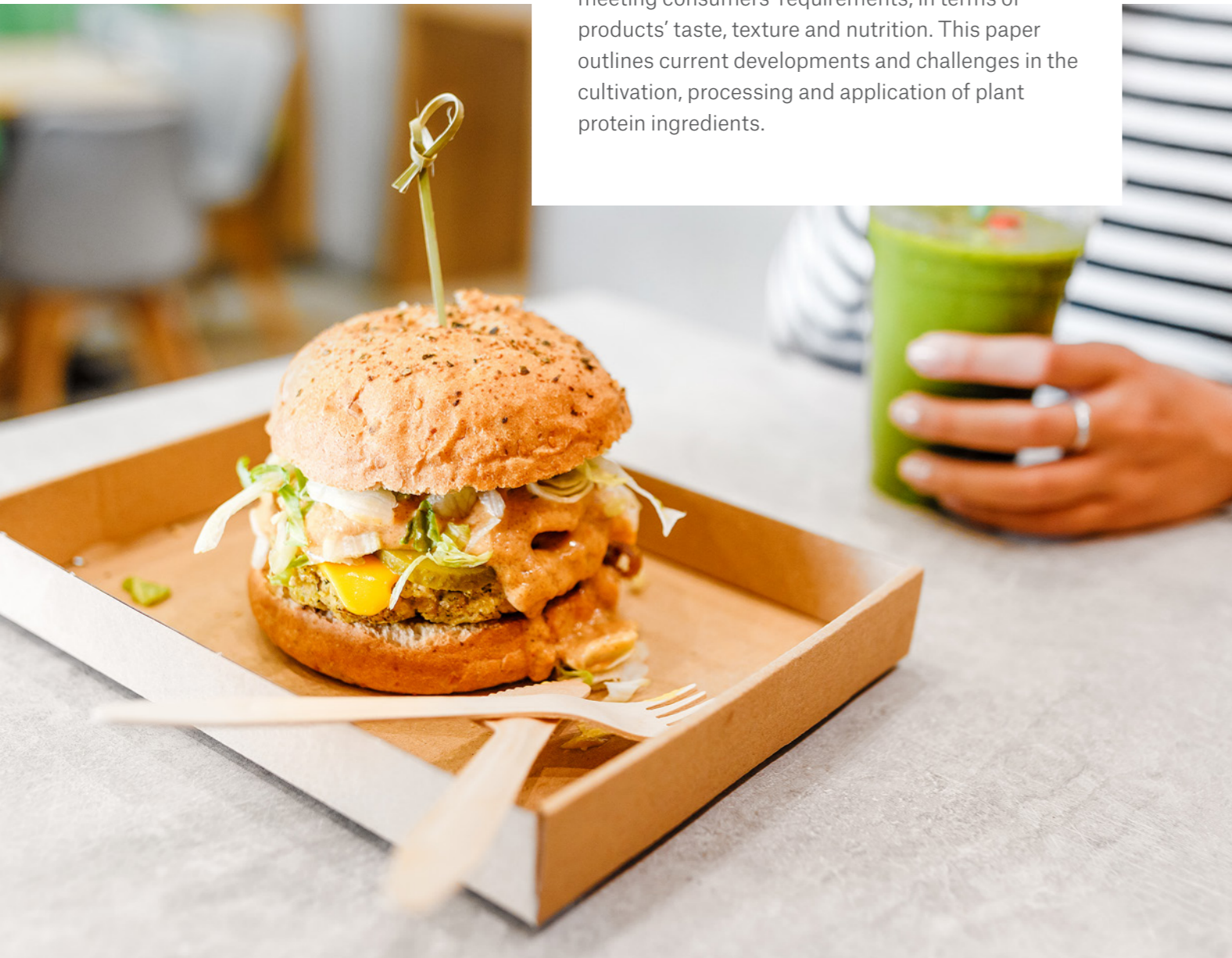


# Harnessing the plant-based movement

How the food & beverage industry can drive focused, brand-relevant plant protein innovation with science, technology and insight.

The soaring interest in plant-based diets has multiple underlying factors and increasingly looks like a lasting trend, not a passing fad. Consequently, the food and beverage industry needs to extend and accelerate the discovery, development and use of plant protein ingredients.

From improving health to fighting climate change, the potential benefits of a plant-based diet regularly hit the headlines. As this once niche market becomes mainstream, the wider food and beverage industry needs to act. But it raises important questions about meeting consumers' requirements, in terms of products' taste, texture and nutrition. This paper outlines current developments and challenges in the cultivation, processing and application of plant protein ingredients.



### What's driving the trend?

Conscious vegetarianism and veganism is on the rise in the Western world. Flexitarianism is also becoming mainstream, as people reduce meat consumption without eradicating it altogether. Many are making a purposeful decision to eat less meat for health or ethical reasons. Concern for animal welfare is one aspect of this, but greater awareness of environmental issues associated with meat production is another factor.

There's also the growing world population to consider. UN figures suggest it will reach 9.6 billion by 2050, with a corresponding 59-98% increase in demand for food<sup>1</sup>. This could result in a serious global protein deficit unless the food and beverage industry delivers innovative new products and production methods. In the coming decades, alternative proteins may be less about the luxury of choice and more about the necessity of feeding the world.

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### Challenges and opportunities

A shift towards plant protein ingredients is not just desirable or on-trend, it's essential. But there are significant barriers to their widespread use in large-scale food and beverage manufacture. These include ingredient functionality, stability and supply sustainability as well as the taste, texture and appearance of end products. Nutrition is also a concern. Even plant products considered relatively protein-rich, such as nuts and legumes, typically contain less than equivalent animal-based products gram for gram.

Delivering plant-based proteins requires consideration and collaborative input from experts in plant breeding, food manufacture, regulation and consumer insight. And it impacts the full spectrum of the food industry, from growers, ingredient suppliers and food processors to retailers and restaurants.

Organisations that rise to the challenge have an opportunity to benefit from the 'vegan halo effect'. In the six months following the launch of its vegan sausage roll, Greggs' profits surged by more than 50%. In an interview with The Guardian, CEO Roger Whiteside said "...it was selling out within

minutes of arriving in the shops. And what was interesting about it was it had a sort of double effect. People arrived looking for that product. But once they were in Greggs they saw what else we did."<sup>2</sup>

It would be easy to get caught up in the current wave of veganism and plant protein innovation. But it's important not to act in haste. Activity needs to be properly thought out to ensure it is authentic, transparent and true to brand values.

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Take the consumer and media responses to Moving Mountains' vegan 'bleeding' burger versus that of Burger King's plant-based Impossible Whopper. The challenges for disruptive new market entrants are quite different to those facing established brands, especially players with a heritage in meat products. People often have preconceived ideas about longstanding brands which may need to be addressed to minimise any negative backlash to new plant-based products.

So, the plant-based trend can be harnessed to engender brand purpose and competitive differentiation. But it needs to be handled carefully, especially by brands that are synonymous with meat. Consumer insight is paramount; it should be used to guide the entire product innovation journey, from concept to end product.

Here, Oakland Innovation sets out some of the key considerations for food and beverage organisations exploring plant protein options. In an environment that is dynamic and continually evolving, our aim is to help you navigate a steady course with focused development and innovation.

### The protein challenge

Protein is a macronutrient, playing an essential role in the build and repair of tissue as well as in the formation of enzymes, hormones and other body chemicals. The human body doesn't store protein; we need a continual supply. So, if consumers are eating less meat, fish and poultry, the relative importance of protein obtained from alternative sources, such as plants, will only increase. However, this is far from straightforward. There are many considerations, from the technical and scientific challenges associated with recovering and processing plant protein ingredients to the sensory qualities of end products and ultimately brand fit.



### Scientific and technical challenges

While there are many plant-based protein sources (see Fig. 1) extracting and processing it efficiently and effectively can be problematic. Plant proteins often contain antinutrients which inhibit absorption, and their amino acid profile is typically different to that of animal-derived products.

The nutritional profile of plant proteins is just one part of the challenge. Naturally, people want plant-based products to be tasty and satisfy all the sensory aspects of good food – from aroma to texture and mouthfeel – as well as being nutritious. However, there are multiple scientific and technical issues associated with the functionality, taste, texture and appearance of plant protein ingredients and the products they're used in.

Broadly speaking, these can be addressed at four key points of the ingredients supply chain: production, extraction, post-processing and recipe development. We'll look at each of them in turn, considering niche developments that could benefit the wider food and beverage industry.

<b>Cereals and grains</b>	Oat, Barley, Rye, Wheat, Corn, Rice, Quinoa, Sorghum, Millet
<b>Legumes</b>	Soybean, pea, lentil, lupin, chickpea
<b>Oil seeds</b>	Sunflower, canola, hemp, flaxseed
<b>Other plant sources</b>	Seaweed, algae, nuts, duckweed

**Fig.1 An overview of plant-based protein sources.** (Mycoprotein, a key ingredient in many meat-free products, is derived from a fungi species called *fusarium venenatum*. Fungi are saprotrophic – they feed on decaying matter rather than synthesising their own food – so are therefore not classified as a plant).

### Production

Breeding and cultivating plants to optimise their nutritional properties for human consumption has long been a subject of scientific research. Cereal crops, ancient grains and legumes remain a key focus from a plant protein perspective.

Legumes are widely recognised as a valuable protein source by the food industry and consumers alike. Soybean, chickpea, lentil, pea and various types of bean are familiar ingredients. From an environmental perspective, greater use of legumes in agriculture also has the potential to increase global food production by enhancing reclamation of marginal land for crop-growing. Their symbiotic relationship with soil-dwelling bacteria results in nitrogen being 'fixed' in the soil, acting like a natural fertilizer. This eradicates the need for the synthetic nitrogen fertilizers upon which cereal crops depend, resulting in a better environmental footprint.

*Protein Crops: Food and Feed for the Future*, an article published by a group of Spanish researchers, advocates increased cultivation of ancient grains such as amaranth and quinoa, which are excellent alternative sources of protein. Their seeds contain lysine, an essential amino acid which is less prominent in the most widely grown cereal crops: "Nutritional evaluations of quinoa indicate that it constitutes a source of complete protein with a good balance of all of the amino acids needed for human diet, and also important minerals, vitamins, high quality oils, and flavonoids."<sup>3</sup>

It's not only land-based crops gaining attention. Edible aquatic plants and autotrophs are also hot contenders for sustainable alternative protein. Seaweed has long been consumed by coastal communities, and research shows that the protein content of red varieties such as *Palmaria palmata* (common name Dulse) and *Porphyra* (served as laverbread in Wales) rivals that of more widely consumed crops such as soybean.

Companies active in this space include Parabel<sup>4</sup>, which has developed a technique to capture the nutritional benefits of duckweed. This fast-growing aquatic plant is an ancient food source that thrives in open water. Parabel has transformed it into an ingredient for the 21st century. Since more than 70 per cent of the earth's surface is water, developments like this could unlock a rich seam of sustainable plant protein.



## Extraction

It's one thing to breed and cultivate plants containing protein. Extracting and capturing that protein in a format suitable for scaled production of palatable food is another matter.

Fractionation, drying and heat treatment processes are commonly used to convert raw materials into ingredients for food processing. From a plant protein perspective, the primary focus is generally related to making the protein available for application, reducing off-tastes and removing unwanted contaminants.

Improving separation techniques to deliver more of the target protein, while minimising costs and any negative environmental impact, is a priority.

For instance, traditional, wet fractionation processes for plant protein ingredient production involve a lot of water wastage and can compromise native protein functionality. However, recent advancements in fractionation could reduce both environmental impact and costs.

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Several factors can affect fractionation protein yields, such as moisture content of the raw material and use of pre-processing techniques like splitting and dehulling. Research is ongoing in this area, and there are still many challenges to overcome. However, in the near future we're likely to see increased supply of protein-rich ingredients, specially prepared for optimum functionality and ease of use in large-scale food processing applications.

## Post-processing

Ultimately, the goal for any plant protein ingredient is achieving good digestibility and meeting human amino acid requirements.

New approaches which evolve traditional methods for large-scale applications are proving very effective here. Studies have shown that fermentation of vegetable proteins has the potential to improve digestibility, nutritive value and tolerability. This ancient practice is regaining popularity and scientists are looking at how it might be used in commercial applications to enhance plant protein ingredient performance.

A study published in 2018 looked at how fermentation and germination might be used to improve the nutritional value of cereals and legumes. It concluded that *"...fermented or germinated foods are superior in nutrients compared to their unfermented or ungerminated counterparts due to activation of endogenous enzymes that degrade antinutritional factors. Antioxidant properties of fermented foods are also elevated compared to their unfermented counterparts due to increased vitamin C and ease of release of different health-promoting bioactive compounds resulting from weakening of grain matrix."*<sup>5</sup>



Embracing traditional techniques like this aligns well with the use of natural methods and recognisable ingredients to enhance clean label credentials. Fermentation is also gaining ground in the functional beverage category where it is associated with gut health, as seen in the popularity of the tea-based drink Kombucha. The process can add a valuable layer of interest to product provenance from a brand development perspective.

## Recipe development

The recipe development phase of the ingredient supply chain is an opportunity to blend different plant protein sources with colours, flavours, preservatives and other additives to improve properties such as texture, function and shelf-life. Since few plant proteins have a complete amino acid profile, it can also be beneficial to blend complementary sources such as legumes and grains.

While it may be necessary to de-bitter or mask certain flavours with more familiar or palatable tastes, clean labelling needs to be a high priority. The plant-based movement is very much aligned with healthy eating, so it could defeat the purpose to use multiple additives, particularly those that are artificial or not readily recognisable. Regulatory considerations also need to be front of mind as certain colours, flavours and preservatives are more strictly controlled in some markets than others. The global regulatory environment is highly complex, and expert guidance is to be recommended on this matter.

Scientific exploration of the best blends of plant-based proteins for different applications is essential. Understanding the properties and functions ingredients must impart to specific end products can help shape decisions about additives as well as ingredient format (e.g. powdered versus texturised). After all, a plant protein ingredient used as a filler for a meat product will have to fulfil entirely different requirements to one used in a standalone vegan product or a protein-enriched beverage.

## Top five considerations for plant protein innovation

- 1 Understand consumer and purchase intentions, and how they relate to your own brand/product proposition.
- 2 Focus on identifying solutions (substrates and suppliers) which can meet the complex needs of your product (taste, texture, nutrition).
- 3 Don't disregard supply chain sustainability – it's easy to create new problems when trying to address the case for moving from animal-based to plant-based protein.
- 4 Consider how supporting technology such as post-processing and fortification can be used to add value to your product proposition.
- 5 You're unlikely to hold all the required skills and knowledge in-house, collaborate with external partners to ensure all bases are covered and increase chances of success.

## Collaboration breeds success

In the coming years, we can expect to see an acceleration in plant protein ingredient innovation, unlocking a wider range of options for the downstream food and beverage industry. Greater supply chain availability and improvements in the texture, taste and nutrition of ingredients and end products will drive a surge in the plant-based category.

Yet, this remains a complex area that demands input from and cohesion between experts in applied science, consumer science and regulatory matters. Combining the latest technical advancements and scientific approaches with regulatory knowledge and consumer insight is key.

So, technical teams need to work closely with sensory scientists and nutritionists to fully understand the scope of requirements and how associated challenges might be overcome.

Furthermore, closer involvement between innovation and brand teams can unlock valuable opportunities to convey the provenance of a product, telling its story from field to plate. In an age where storytelling and purpose are often central to brand strategy, supporting farmers and fostering ecologically sound ingredient production speaks volumes. A joined-up approach can provide a strategic platform for differentiation and competitive advantage.

### Footnotes

1. United Nations Dept. of Economic and Social Affairs (2015) World Population Prospects, Elferinkand Schierhorn, 2016
2. The vegan halo: how plant-based products are transforming British brands, by Richard Godwin, published in The Guardian <https://www.theguardian.com/lifeandstyle/2019/sep/03/the-vegan-halo-how-plant-based-products-are-transforming-british-brands>
3. Protein Crops: Food and Feed for the Future, by Antonio M. De Ron, Francesca Sparvoli, José J. Pueyo and Didier Bazile, published in Frontiers in Plant Science <https://www.frontiersin.org/articles/10.3389/fpls.2017.00105/full>
4. Parabel <http://www.parabel.com/>
5. Fermentation and germination improve nutritional value of cereals and legumes through activation of endogenous enzymes, by Smith G. Nkhata, Emmanuel Ayua, Elijah H. Kamau and Jean-Bosco Shingiro <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6261201/>

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