



# Upcycled Barley: The Protein Brewery



Cierzo Brewing Co., a Spanish beer brewing company, uses barley malt instead of other cheaper cereals, such as corn or rice.

The beer brewing industry has made significant strides in upcycling spent grains into valuable protein ingredients. What matters is discovering natural barley protein application opportunities and proprietary technologies that are responsible for sustainable sourcing while amplifying the best from nature, taste, nutrition, and health. Contributed by Henk Hoogenkamp.

**T**he US\$ 600bn global market for beer-brewing companies around the world have vast amounts of barley-spent grain available that otherwise would be sold as a source of high-protein feedstock. In recent years, barley-spent grain has undergone a 'trash-to-treasure' transformation and proprietary technology refinements now allow valuable macro- and micro components to be captured for use in food products, including beverages, bakery, and plant- or hybrid meat foods.

Derived from barley and small amounts of corn or rice, the protein ingredients are designed to deliver the optimum nutritional profile, great organoleptic performance, sustainability, and consumer-preferred status of clean natural label and non-soy. As such, there is an obvious shift to including more upcycled ingredients that will continue to play a major role in human nutrition.

## More Plant

For example: a staggering 77 percent of the protein consumed in the EU is imported. About 58 percent of the consumed protein is of animal origin, which is less sustainable compared to plant protein. To change these statistics, it will be essential to upcycle by-products of vegetable cultivation that are rich in high nutritional amino acid proteins. The valorisation of these waste streams will become a main driver to further enhance the availability of highly nutritional and functional protein sources for human consumption.

The barley spent grains are derived from natural resources via a vertically integrated global supply chain. This allows quality assurance of the premium barley protein including the rollout, which meets the evolving needs of consumers for soy-free options to harness ecological sustainability conditions and meet



clean label targets. The latter is important because the food industry is increasingly confronted with consumers that are continually gravitating toward ingredients they associate with natural sources, putting pressure on brands to find alternative solutions like the barley protein range of ingredients.

### Light is the Name

Native or targeted enzymatically-modified barley protein has excellent emulsifying and interfacial film-forming properties reducing the tension between water and oil droplets. The high encapsulation efficiency of barley protein is stable at low pH, and it reduces oxidative degradation which may increase the shelf life of a processed food product.

As a continuing way to improve quality properties of barley protein, scientists have been able to significantly whiten the colour of the barley protein isolate. This is a breakthrough, which now opens a much larger application platform for food and beverage products including dairy, vegan cheeses, snacks, including extruded crisps for cereals and nutria-bars.

### A Sustainable Choice

Currently, the most dominant plant protein ingredients are wheat, soy, and pea. Multiple new plant protein

ingredients have been introduced over the last 10 years. While some have intrinsic flaws such as limited availability, others are a great welcome to the toolbox of food formulators.

Barley protein, made from the abundant byproducts of traditional beer brewing, delivers a complete protein product, containing all the highly nutritive amino acids needed, as well as showing great application performance and organoleptic properties. The premise of barley is simple: the grain doesn't need much to grow, and it is hailed as a sustainable crop compared to soybean (which has been linked to deforestation) and almond (which uses a lot of water to produce).

Barley, and especially barley-spent grain, is emerging as a formidable alternative to the current selections of plant protein sources like soy and pea. The barley grain can be seen as a highly sustainable game-changing plant protein, considering it will get a second life after the beer fermentation processes have been completed. Barley protein ingredients help to swap out additives.



Malted barley grains for beer brewing.

### More than Just Protein

Upcycled barley protein is the next level of plant-based solutions that enable clean labels and consumer-preferred claims, while ensuring cost-efficient and reliable performance across a wide range of applications adding superior organoleptic functionality. Spent barley ingredients are nature-powered, recognisable proteins and fibres solving key challenges for clean label-friendly applications for processed food, beverages, and meat products.

One of the main problems for companies that promote plant protein ingredients is to find commercially viable options to successfully sell the remaining carbohydrates and fibre. The valorisation of these components often makes or breaks the successful business case for the protein component. The latter is the main reason why soy is leading because of its high oil content and lecithin, which are in great demand globally.

### Powered by Upcycling Sustainability Performance

Beer brewing waste can be seen as a concentration of protein, fibre, and some other micro-nutrients. Instead of using the beer leftover material for animal nutrition, innovative recovery systems now repurpose the valuable waste for upgrading to premium ingredients that can be used in a plethora of formulated foods, beverages, and (plant)meat products.

There is no doubt that plant protein-formulated foods and beverages are getting more essential for the health of both humans and planet Earth. The most interesting emerging plant proteins are mung bean, fava, chickpea, oat, barley, canola, and sunflower. Plant proteins need to not only fulfill important parameters such as yield per hectare, land availability for cultivation, water requirements, and fertilizers, but also take the protein properties and their side-streams into consideration. The waste biomass from the fermentation and downstream recovery streams can be recycled back into the system or made useful for other (food or feed) industries, as well as compacted into “zero-waste” eco-friendly building and packaging.

Barley is a pragmatic choice to convert spent grain into an emerging source of plant protein solutions for use in a wide range of formulated food products. Seen from this perspective, barley is a welcome source to help alleviate possible future supply-chain protein shortages for a world that is in urgent need to transition into more sustainable food choices.



Organic bio hop for craftbeer, grown in Upper Franconia.

Barley spent grain has received the prestigious Upcycled Food Association certification. It is anticipated that these certifications and their natural status will become a main qualifier for formulated foods and beverage products, which includes displaying packaging label claims. The same is true for signaling protein ingredients with important parameters such as carbon footprint, water & land use, and avoidance of deforestation and wildlife habitat destruction. Subsequently, upcycled nutrition and performance, as well as ecological sustainability, will move forward in tandem to meet the increasing global demand for plant protein ingredients.

### More than One

Especially the younger generation of consumers prefer food and beverage products that are made with sustainable ingredients that they recognise and trust. The plant-based barley grain has a positive consumer-identifiable name and health perception with all the ace-cards to become trending in a diverse range of applications such as dry-blended beverages, nutribars, bakery fillings, confectionary, and plant- or hybrid meat products.

The objective of most functional plant ingredients is to find ways to create high concentrations of the target components such as high protein content, high dietary fibre content, and other micronutrients like phytochemicals.

The four pillars to build plant protein ingredients are great taste/flavour, function, nutrition, and cost. Exploring innovation-driven research to improve taste, texture, and colour is therefore a main part of the transformation needed to sustainably feed a growing global population.

## The Ancient Barley Brewing Story

Since the early civilisation in Mesopotamia dating back between 3500 and 3100 BC, barley grain has been an age-tested grain which has been used together with the hop flower or hop cone as the key ingredient for beer to produce a distinct flavour and aroma with the desired bitterness.

German immigrants settling in Michigan introduced the modern beer brewing principles in the US around 1850. Anheuser-Busch started their success story during that time. Brewer's grain (also known as malt) is produced predominantly by sprouting barley. This is an age-tested method that dates back to the very early human settler societies.

Prior to the Anheuser-Busch era, beer brewing arrived in North America in 1632. The very first brewery was set up in New Amsterdam, later renamed New York, on Brewer Street, now known as Stone Street.



New York has a huge craft beer scene with over 380 craft breweries operating in the state. According to the Brewers Association, New York produces 1,270,157 barrels of craft beer per year. New York ranks fourth for the highest number of breweries in the United States.

The possible future posterchild of plant-based products is the ongoing transition of barely grain and spent barley grain into a premium organoleptic and nutritional ingredient. The beer brewing fermentation process removes most of the soluble carbohydrates, as well as some soluble protein fractions.

Craft beer brewers especially like barley because the sugars in the starch are easily converted into alcohol in the brewing fermentation process. The residual side-stream protein still has unique features as these components can be naturally captured and modified for upstream protein and fibre solutions for many foods and plant meat applications.

The premier barley ingredient of EverGrain is the Everpro isolate plant-forward product that classifies as a complete protein and is a great flavour enhancer, dairy-free and soy-free. The ingredient provides a low-cost solution, requiring short hydration times and fewer mechanical inputs for gelation of fat emulsification. This spent barley protein can further enhance nutritional profiles when used in tandem with other plant or animal-based protein formulated foods.

## Protein Recovery Methods

- Chemical extraction
- Dry fragmentation separation
- Precision fermentation

Native barley grain has a protein content of 10 percent, a fat content of 10 percent, with carbohydrates, fibre, and roughage cell walls as the balance. Both physical and chemical methods can be used to obtain the separation of the various compounds that are embedded in the plant substrate. Chemical processing entails the use of a sequence of treatments that involve temperature, pH, alkaline, acids, as well as enzymes to modify protein performance.

To maintain a natural status, however, dry fragmentation is gaining popularity as the process does not need chemicals and vast amounts of clean water for centrifuging, as well as expensive energy for spray or drum-drying. Physical separation is a time-tested process with dry/air fragmentation and follows steps such as de-husking, sieving, heat stabilising, and final grinding. Physical plant treatment



Different colours can be achieved with Everpro Clear. This illustration shows Everpro Clear at 5% concentration with various colours.

systems are usually the most cost efficient. Because of the high demand for “green & clean” food labels, air fragmentation has become a popular choice to maintain the all-natural characteristics of the individual plant protein or plant fibre ingredient.

### A Welcome Biodiverse Protein

Protein is essential to proper nutrition. Barley protein is a single ingredient offering dual-function solutions for improved nutritive value and formulation

challenges. Barley protein is an excellent source of essential amino acids, and especially the branched-chain amino acids (BCAAs) are considered impressive. Barley protein therefore compares favorably to whey protein and, when blended with whey protein and/or infused with lysine or leucine, a DIAAS of 1.00 can be reached.

Premium protein ingredients have not only been in demand for sport nutrition supplementation but have also become a purchase driver for mainstream consumers looking for holistic wellness and prevention of age-related muscle loss (sarcopenia).

Barley proteins offer health benefits with a punch: much like whey lactoglobulin and egg albumen, has shorter protein chains, which translates to much shorter digestion and absorption once ingested. This makes barley protein especially suitable for target nutrition such as sport and wellness, as well as for clinical dietary supplements.

Beer brewing removes the soluble carbohydrates, hence most insoluble non-digestible fibre remains. These remaining fibres are closely intertwined which promotes good intestinal health with little or no bloating and other digestive problems.

### Barley: A New Contender for Sustainable Plant-Based Protein Ingredients

Upcycling by-products that would otherwise be discarded as waste for landfill or animal feed is now increasing global availability of nutritious and functional plant protein ingredients. Barley grains and its long history of inherent goodness have evolved in a series of functional and nutritious plant-based ingredients, which are now emerging as a serious challenger for the soy and pea domination. **APFI**

Barley protein has a wide range of applications in the F&B industry, such as bakery and confectionery products, smoothies, dairy, and vegan cheeses.



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