Creating beverages with unmalted barley

Barley is a traditional raw material used in the production of beer. To convert barley grains into fermentable wort, enzymes are needed to break down cell walls, release amino acids and break down starches into fermentable sugars.

Novozymes Ondea® Pro makes it possible to generate a standard fermentable wort with any proportion of barley under regular brewing conditions.
With Ondea® Pro, the quality requirements for barley are less strict compared to barley used for malting. This allows for greater flexibility in sourcing different barley qualities.

Benefits

1. Maximize use of raw materials and cost savings
   - Higher extract yield
   - Enables the use of unmalted barley
   - Efficient wort and beer filtration
   - Control of FAN (free amino nitrogen) and fermentability
   - Improved foam stability
   - Fit with standard equipment and mashing times
   - High adjunct decoction is possible
   - High Gravity Brewing with up to 26°P (first wort) is possible
   - Production of high-quality beer
   - Flexible sourcing of raw materials

2. Reduce carbon footprint
   - CO_2 emissions can be reduced by ≤8%
   - Save ≤3 kg CO_2 per hl of beer

3. Increase the platform for new branding
   - A beer based on up to 100% barley
   - Flexibility to match the current beer profile

Product

Ondea® Pro is a multi-enzyme blend formulated to secure efficient viscosity, turbidity reduction, protein degradation, and controlled attenuation. The enzyme works in synergy with the barley's endogenous enzymes to produce fermentable wort. In conjunction with endogenous barley proteases and β-amylases, the enzymes in Ondea® Pro create synergetic effects to achieve the most successful brewing results.

Usage and dosage recommendations

Raw material quality

Barley with high enzyme activity is required when using Ondea® Pro. As a raw material for beer production, barley must comply with respective national and regional regulations for food use regarding mycotoxins, pesticide residues and heavy metals. It must also be free of foreign material such as stones, wood, and metal particles. Furthermore, no more than 4% of barley may be ≤2.2 mm in size. The extract yield achieved from barley is like that achieved with dry-basis malt.

Milling

In contrast to malt, barley is significantly harder and has a higher initial water content (approx. 12–14%). To ensure comparable performance, the mill needs to be adjusted to a higher power uptake.

Mash filter

For mash filter use, a standard hammer milling procedure (with adjusted power uptake), or any comparable system such as *Dispax*, is sufficient. When cleaning the mash filter, spent grains will fall off the filter sheet most efficiently when the dry matter load is comparable to that of malt. To achieve similar gravity, mashing water should be reduced accordingly.

Lauter tuns

When using a lauter tun, milling and resulting grist composition are critical to good lauter performance. Husk preservation is vital for effectively building up the filter bed. For good milling results, it is recommended to use barley of a homogeneous size of >2.2 mm. Two-, four- and six-roller mills can be used. The mill settings need to be adjusted for barley processing.
Recommended grist composition is shown in figure 1.

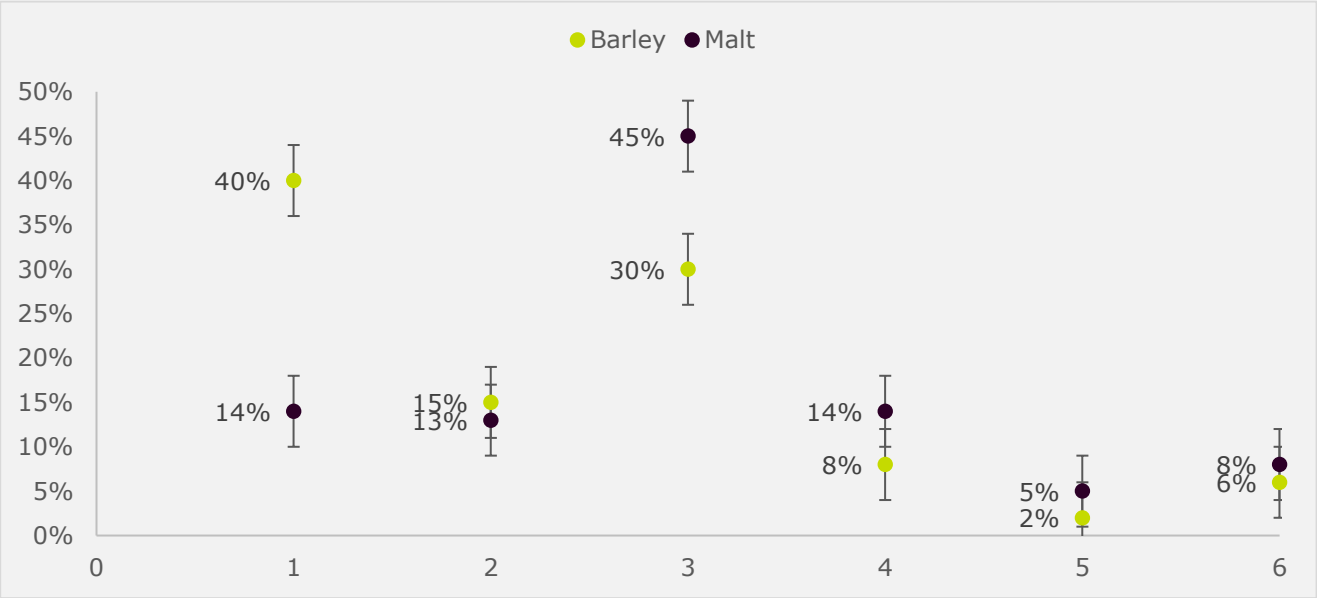

Fig. 1. Recommended particle size distribution [%] of barley, compared to typical values for malt, captured as sieve residuals

The grist composition for barley needs to be coarser than for malt, which is critical for good lautering performance.

Please contact our Technical Service department for further information on mill setting guidelines.

- **Mashing-in**
  Typically, temperature of 53°C, 15-30 minutes

- **Mashing temperature**
  Ensure that the highest temperature during mashing-in and throughout the first 30 minutes (protein rest) does not exceed 53°C. Saccharification time should not exceed 64°C to support the performance of the heat-sensitive barley β-amylase.

- **Mashing pH**
  The natural barley mashing pH of typically ≥5.7 should not be decreased below 5.6 and should not be higher than 5.9 to avoid high turbidity.

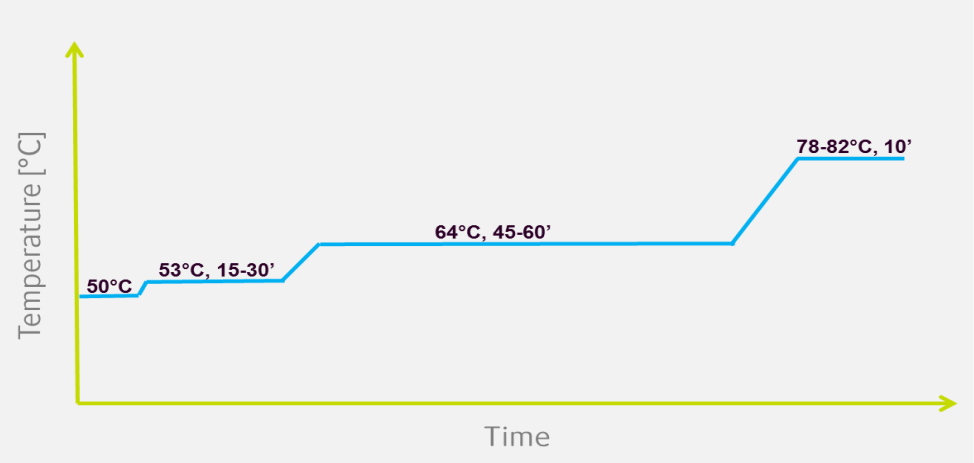

Fig. 2. Example of infusion mashing to achieve 70% RDF (real degree of fermentation)

- **Mash agitation**
  Continuous stirring is required throughout mashing to prevent the settling down of grist and ensure good enzyme performance.

- **Iodine test**
  The typical iodine test carried out after saccharification might still be positive when brewing with Ondea® Pro. This is not an issue, as Ondea® Pro contains a thermostable α-amylase that still degrades starch during mashing-off and lautering. The final filtrate in the kettle will always be iodine-normal.

- **Wort pH**
  The wort must be acidified to a pH of 5.2 before boiling to support the pH drop during fermentation.

- **Hopping**
  Experience with 100%-barley beer shows that 10–20 % less hopping is required to achieve a similar bitterness perception.

- **FAN control**
  In case higher FAN levels are needed, an extended rest at 50°C for 30–60 minutes is recommended.

Proteolytic components work in synergy with the endogenous enzymes of barley. FAN generation is directly linked to grain protein content. Using barley with a high protein content can be an advantage in Ondea® brewing. The FAN in barley wort is easier to assimilate by the yeast, therefore, the barley wort needs only 9–12 mg FAN/L/°P to ensure good fermentation.

- **Sugar profile and fermentability**

Ondea® Pro results in a maltose-based sugar profile (fig. 3). Should a different sugar profile be favored, apply changes in the mash profile and/or an additional dosage of Attenuzyme®.

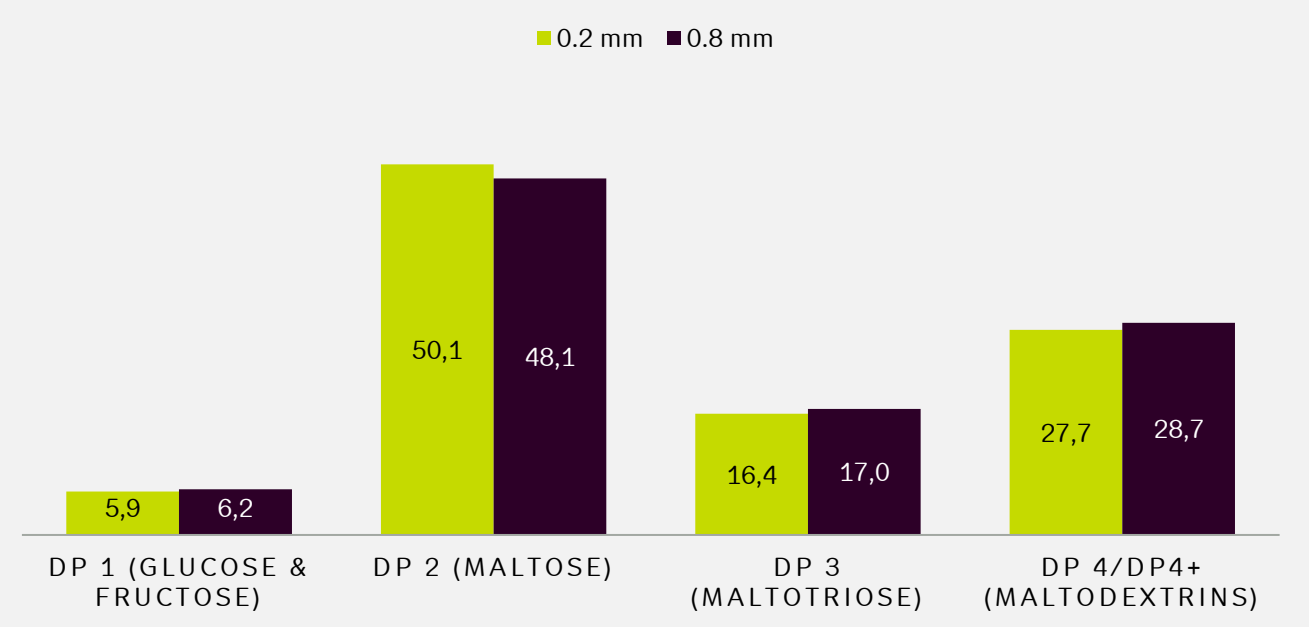

Fig. 3. Sugar profile of a wort processed with 100% barley using a fine and coarse milling set-up

Malt inclusion

Ondea® Pro is designed to brew a standard beer based on 100%-unmalted barley, but malt inclusion is possible and should be considered as a tool to:

- Obtain desired beer taste directly, if blending is not an option
- Generate more FAN and fermentable sugars
- Improve lauter performance related to raw material quality and process variation

Ondea® Pro is also suitable to produce flavored beers or any type of non-alcoholic grain-based beverage. In addition, it is possible to produce extracts from unmalted cereals.

Additional information can be found in the “Brewing Handbook” and “Brewing Calculator,” both available at Novozymes Market. More detailed guidelines are available upon request, including a barley evaluation test developed by Novozymes called the “Barley Quality Test”.

Dosage

Ondea® Pro **1.2–2.2 kg/ton of barley (depending on malt-barley ratio)**

The dosage depends on the amount of barley used in the recipe. Higher amounts of barley require a higher dosage of Ondea® Pro per ton of barley, while higher malt inclusion reduces the dosage of Ondea® Pro required per ton of barley. The enzyme should be dosed at the start of mashing-in, when approx. 30% of the grist is loaded.

Products data

Ondea® Pro	
Declared enzyme	Pullulanase
Other activities	α-amylase, cellulase, xylanase (endo-1,4-), protease (neutral), lipase
Catalyzes the following reaction:	Pullulanase hydrolyzes (1,6)- α-D-glucosidic linkages in pullulan, amylopectin and glycogen
Declared activity	637 PUN/g
E.C/ I.U.B. no.:	3.2.1.41
Physical form	Liquid
Production method	The enzyme product is manufactured via fermentation of microorganisms not present in the final product. Some of the production organisms and the enzyme effectiveness are improved by means of modern biotechnology
Density	1.21 g/ml

More information about the products is available at Novozymes Market.

Stability

Please see the Product Data Sheet at Novozymes Market.

Safety, handling and storage

Safety, handling and storage guidelines are provided with all products.

Get ahead

Staying ahead of the dynamic food and beverage market requires the best technology and expertise to become even more flexible, efficient and profitable. With our solutions and expertise, Novozymes can support you on that journey. Let's transform the quality and sustainability of your business together.

About Novozymes
Novozymes is the world leader in biological solutions. Together with customers, partners and the global community, we improve industrial performance while preserving the planet's resources and helping build better lives. As the world's largest provider of enzyme and microbial technologies, our bioinnovation enables higher agricultural yields, low-temperature washing, energy-efficient production, renewable fuel and many other benefits that we rely on today and in the future. We call it Rethink Tomorrow.

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