Optimizing your use of raw material

High-gelatinizing adjuncts are often used in brewing to reduce costs and improve additional features such as drinkability, flavor, taste and mouthfeel.

The most common high-gelatinizing adjuncts are corn, rice, sorghum and cassava. These adjuncts require an exclusive cereal-cooking step for starch gelatinization, which leads to increased costs, additional manpower and complexity.

Benefits

1. Process simplification
    - Avoiding the cereal-cooking process
    - Processing of high-gelatinizing adjuncts via an infusion mashing process
    - Liquefaction of adjunct starch below gelatinization temperature through native starch de-branching enzymes
    - Reduced downtime (Clean in Place)
    - No need for cooling in case of very high adjunct inclusions
    - Eliminates costs spent on a cereal cooker

2. Raw material flexibility
    - Adjunct inclusion is completely flexible
    - Possible savings on raw materials replacing pre-gelatinized flakes

3. Energy savings
    - No need for cereal cooking
    - Potential shorter total mashing time and optimal temperature profile

Product

Novozymes Ceremix® Flex contains enzymes that

- Ensure efficient liquefaction of adjunct starch below gelatinization temperature
- Produce similar maltose levels, more glucose and less dextrin in comparison with decoction mashing

The enzyme works in synergy with the endogenous enzymes of malt and adjuncts.

Overview of applications and performance

Ceremix® Flex makes it possible to avoid the cereal-cooking step, using only classical infusion mashing for high-gelatinizing adjuncts. It ensures a high maltose-based sugar profile and good attenuation. With Ceremix® Flex, different adjuncts can be mashed-in in the same brew.

Cereal/adjunct	Gelatinization temperature [C°]
Cassava	64–76
Maize (corn)	64–82
Rice	68–84
Sorghum	68–75

Table 1. Gelatinization temperature of selected high-gelatinizing raw materials

Fermentability and RDF

Mashing with rice adjuncts and maize grits yielded results comparable to higher levels of RDF (real degree of fermentation) when using Ceremix® Flex in an infusion-mashing process compared with a classical decoction process.

Table 2 shows a higher RDF (real degree of fermentation) when using Ceremix® Flex.

Adjunct	Wort separation	$RDF_{infusion}$ [%]	$RDF_{Decoction}$ [%]	$\Delta_{infusion-decoction}$ [%]
Maize grits	Lauter tun	69.9	67.8	+2.2
Rice	Lauter tun	75.2	67.4	+7.7
Maize grits	Mash filter	69.8	68.0	+1.8
Rice	Mash filter	74.0	67.9	+6.1

Table 2. Comparison of RDF from cast-out wort sugar profile with 60% malt and 40% adjunct at pilot scale

When compared with conventional adjunct cooking trials, sufficient overall extract yields were obtained in the infusion mashing trials.

A higher dosage of Ceremix® Flex was shown to increase attenuation of all adjuncts by decreasing the dextrin content in the mash and increasing maltose and glucose levels.

Sugar profile

Figure 1 shows a comparison of a 50%-maize and 50%-malt brew using a classical decoction process and a novel infusion mash that includes Ceremix® Flex.

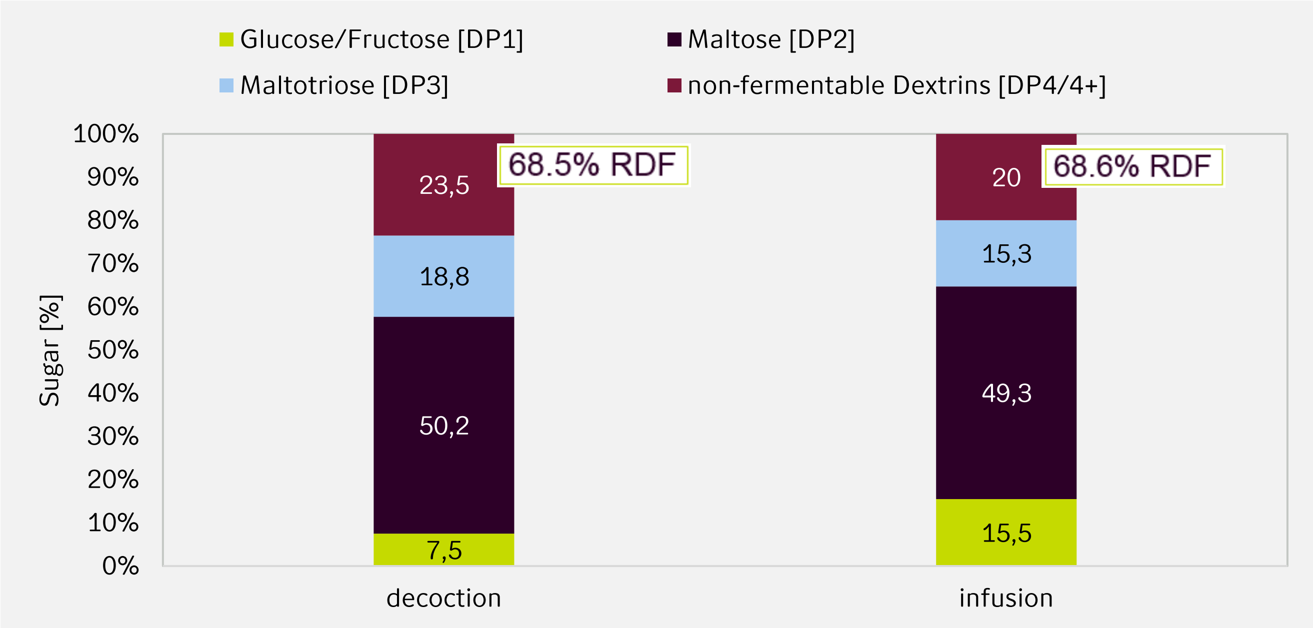

Fig. 1. Comparison of a decoction-produced wort (50% malt, 50% maize) and an infusion-produced wort (50% malt, 50% maize) using Ceremix® Flex

The sugar profile in the infusion mashing was changed slightly from that of the decoction mashing, maintaining the high maltose level (≥46%).
Sufficient overall extract yields were obtained in both the infusion-mashing trials and the conventional adjunct cooking trials, which both produced defect-free beer with no off-flavors. Body, taste and foam retention in the Ceremix® Flex-brewed beer were like those of the decoction-cooked beer.

Similar results were observed when using corn and rice starches as adjuncts in pilot-trial brews.

Energy savings potential

Consumption	(MJ/hl)
Mashing (incl. 15-min cereal cooking)	10.8
Heating up mash to a boiling temperature	15
Boiling (5% EV)	12.2
Total brew house energy consumption	38
Savings potential (by cutting out cereal cooking)	1.5–3.0
Brew house savings potential	4–8%

Table 3. Energy-saving potential when using Ceremix® Flex to avoid additional a cereal-cooking step

Sensory evaluation
Sensory evaluation of the beers produced using Ceremix® Flex showed that substituting the decoction mashing with infusion mashing using Ceremix® Flex resulted in a similar taste profile (figure 3).

Intensity of individual flavors, scored 0–5

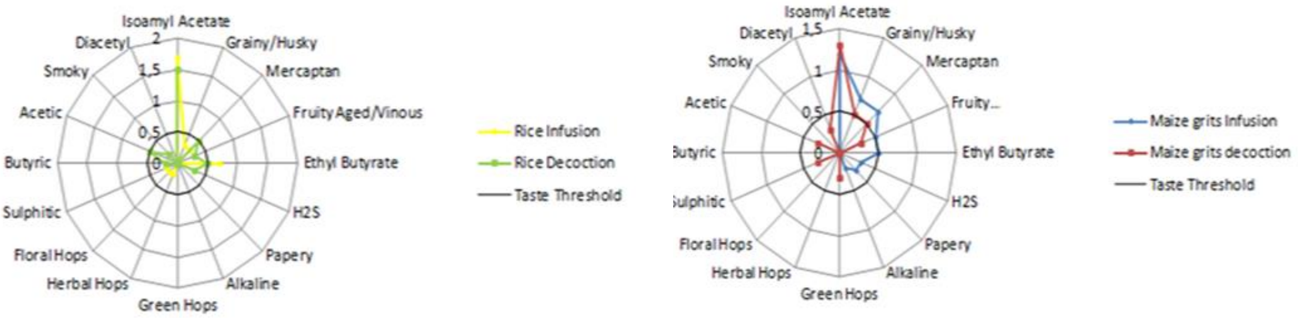

Fig. 3. Sensory evaluation with 50% adjunct and 50% malt at pilot scale

Performance and usage

Mashing diagram when working with Ceremix® Flex

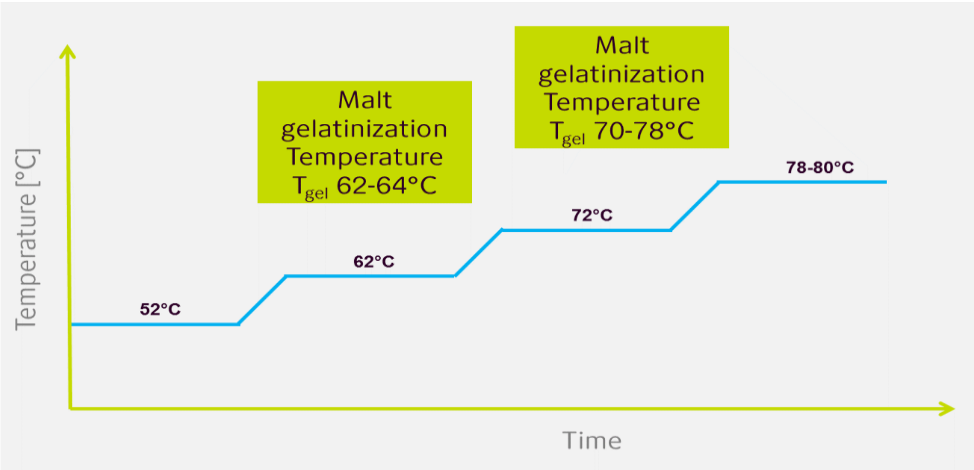

Fig. 4. Recommended infusion mashing diagram when working with Ceremix® Flex to process a high-gelatinizing adjunct

Application details

Grist	Profile	Objectives
Malt and/or barley + high-gelatinizing adjuncts	52°C, 20 min. 62–64°C, 30–60 min. 72°C, 10–30 min. 80°C, 20–30 min.	• Proteolytic rest for FAN generation • 62–64°C for attenuation • 72°C utilization of malt/barley α-amylases • 80°C for achieving yield
100% high-gelatinizing adjuncts	62–64°C, 45–60 min. 80°C, 20–40 min.	• 52°C is optional based on the protein content of HG adjuncts • 62–64°C for attenuation • 80°C for achieving yield

Table 4. Mashing recommendations and objectives depending on the ratio of high-gelatinizing adjuncts

Dosage recommendations

Ceremix® Flex **2.0–5.0 kg/ton of adjunct**

The dosage is dependent on the mashing profile, RDF requirement and style of beer. Please visit Novozymes Market for more information, or contact our Technical Service department for further support.

Product data

Ceremix® Flex	
Declared enzyme	Maltogenic amylase
Catalyzes the following reaction:	Hydrolyses (1,4)-alpha-D-glucosidic linkages in polysaccharides
Declared activity	4400 MANU/g
E.C/I.U.B. no.:	3.2.1.1
Physical form	Liquid
Production method	This product is not a GMO. The enzyme product is manufactured via fermentation of microorganisms not present in the final product. Some of the production organisms are improved by means of modern biotechnology
Density	1.2 g/ml

More information about this project 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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