KERRY

Enzyme Experts

Expertise in Distilling Ingredients

Process & Product Development

Kerry Team

Process optimization technology and applications:

- Eoin Lalor – Global
- Deborah Waters – Global
- Chika Ezeani – North America

Supported by application experts in:

- Enzymology
- Brewing ingredients
- Taste & flavor technologies

Commercial support:

- Aaron Dow, Sales
- Amanda Wolff, Marketing

Craft distilling continues to grow in the US

> The craft spirits market is projected to grow, witnessing a CAGR of 18.87% during the forecast period (2020-2025).
> *-Mordor Intelligence*

> The craft spirits market has the potential to grow by USD 36.82 billion during 2021-2025 [and] 42% of the growth will originate from North America.
> *-technavio*

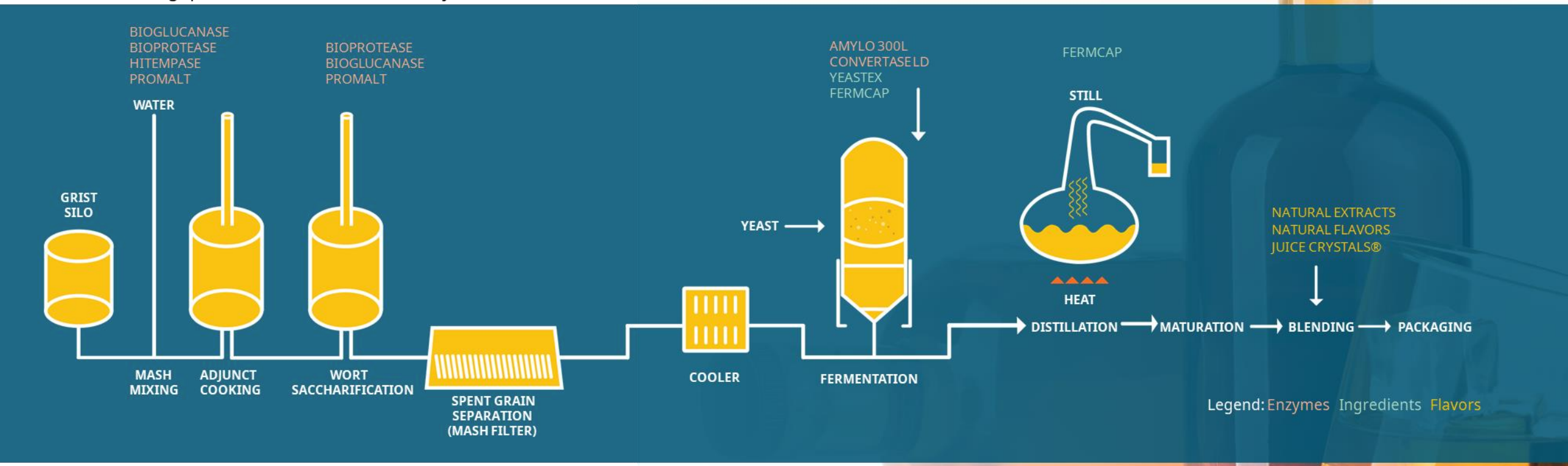
> The global craft spirits market…is expected to grow…owing to growing consumer tastes and preferences towards unconventional and experimental alcoholic beverages.
> *-Grand View Research*

Sources: Mordor Intelligence; Grand View Research; Technavio.

Enzymes, Ingredients & Flavors

SUSTAINABLE SOLUTIONS ACROSS THE DISTILLING PROCESS

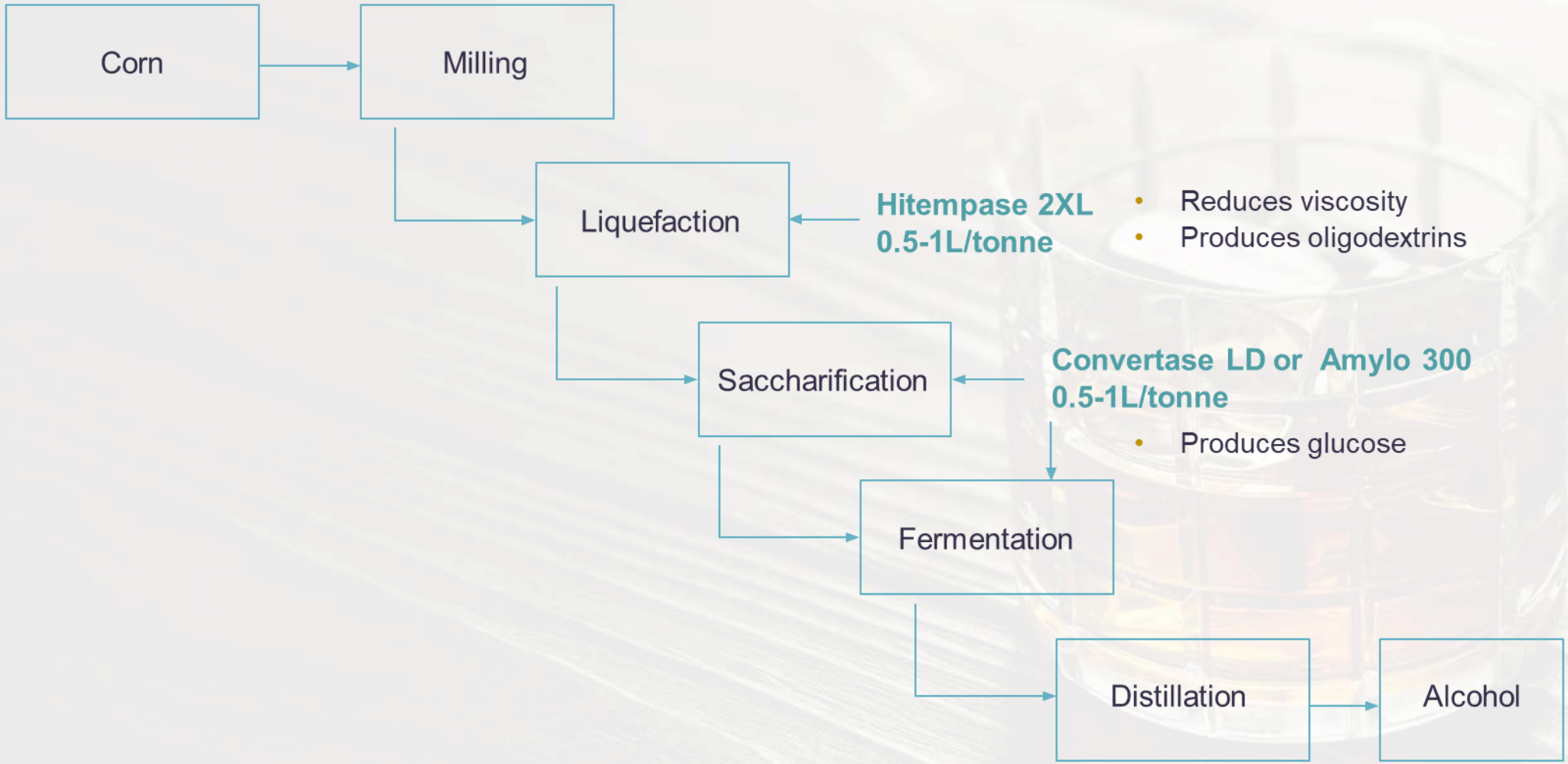
- Complete liquefaction of adjunct
- Obtain maximum extract with good run-off/mash filter throughput
- Dextrin/glucan degradation
- Increased fermentability
- Reduced foaming
- Increased fermentability
- Reduced foaming



Content

- **Applications**
  - **Corn**
  - **Rye**
  - **Wheat**
  - **Malt/Barley**
- **Ingredient Summary**
- **Sustainability**

Enzymes for Corn Processing



Corn process yield optimization examples

Extract optimization with Hitempase STXL conc batch process:

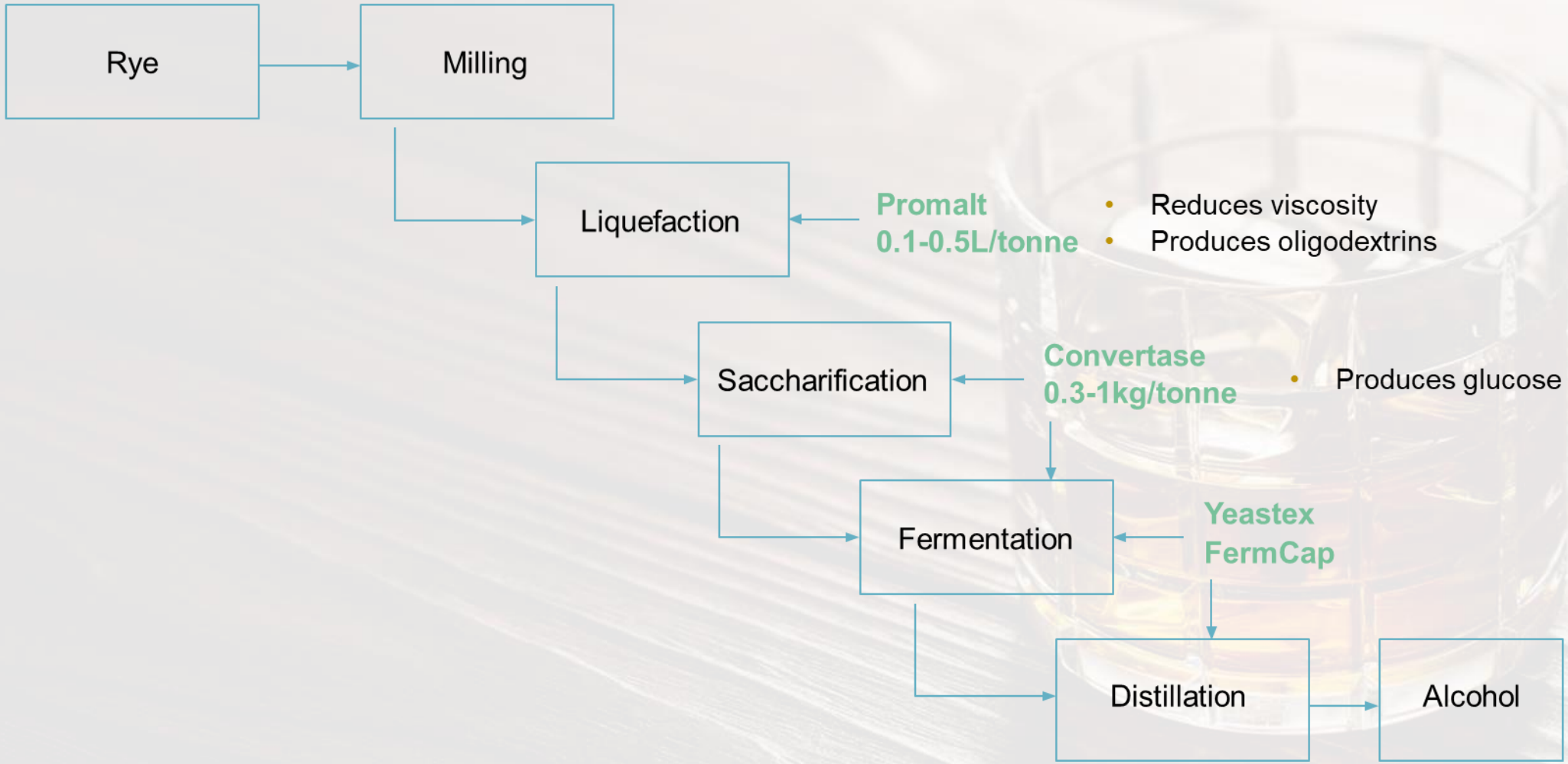
	Kg/t Corn grits	ºP	%Extract (w/w dry)
Hitempase STXL Conc	0.4 0.5 0.7 0.9	12.8 12.8 12.8 13.1	74.8 75.6 76.5 79.8

Extract optimization with Hitempase STXL and amylo continuous process:

Enzyme formulation	2 hours at 63°C		4 hours at 63°C		5 hours at 63°C	
	°Brix	Sugars (g/l)	°Brix	Sugars (g/l)	°Brix	Sugars (g/l)
Kerry 1	22.5	76.99	22.5	111.74	23.55	139.47
Kerry 2	23.19	96.92	22.5	125	23.06	144.02
Kerry 3	22.56	106.88	22.5	178.55	23.06	169.38

Trial	Hitempase on mash in 0.3 L/t starch	Amylo in saccharfication stand L/t
Kerry 1	70°C → 90°C. Hold for 50 min.	1.0
Kerry 2	70°C → 90°C. Hold for 60 min.	1.0
Kerry 3	70°C → 90°C. Hold for 60 min.	1.2

Enzymes for Rye Processing



Rye process yield optimization examples

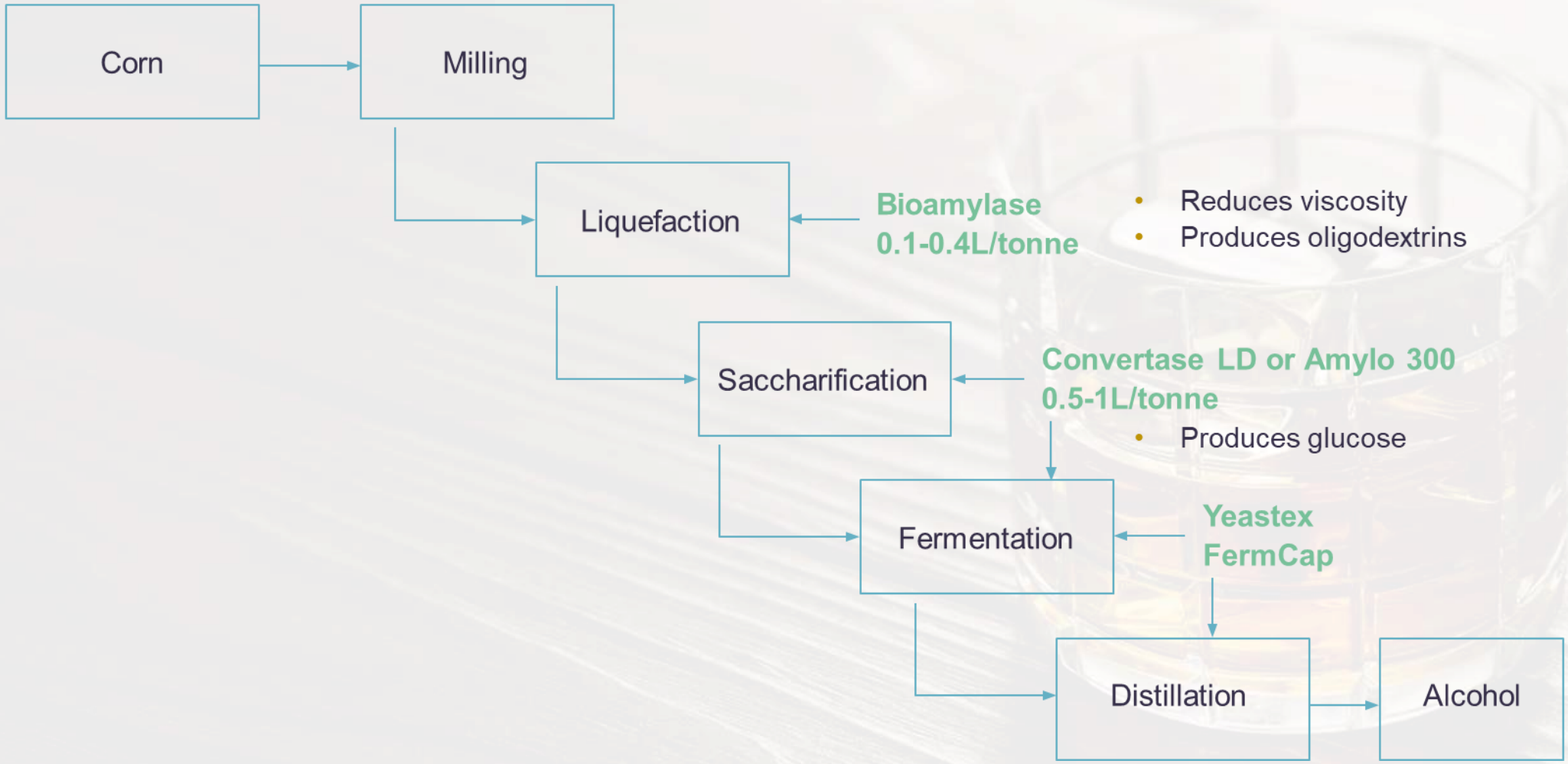
Enzyme	Dose (g/tonne)	Alcohol Yield (litres/tonne dry)
Hitempase Amylo 300	500 1,000	408.4

Enzyme	Dose (g/tonne)	Alcohol Yield (litres/tonne dry)
Hitempase Promalt Amylo 300	500 500 1,000	10.6 414.0

Enzyme	Dose (g/tonne)	Alcohol Yield (litres/tonne dry)
Hitempase Bioglucanase Bioprotease Amylo 300	500 130 120 1,000	415.5 415.3

Enzyme	Dose (g/tonne)	Alcohol Yield (litres/tonne dry)
Hitempase Bioglucanase Bioprotease Amylo 300	1,000 130 120 850	416.6 417.6

Enzymes for Wheat Processing



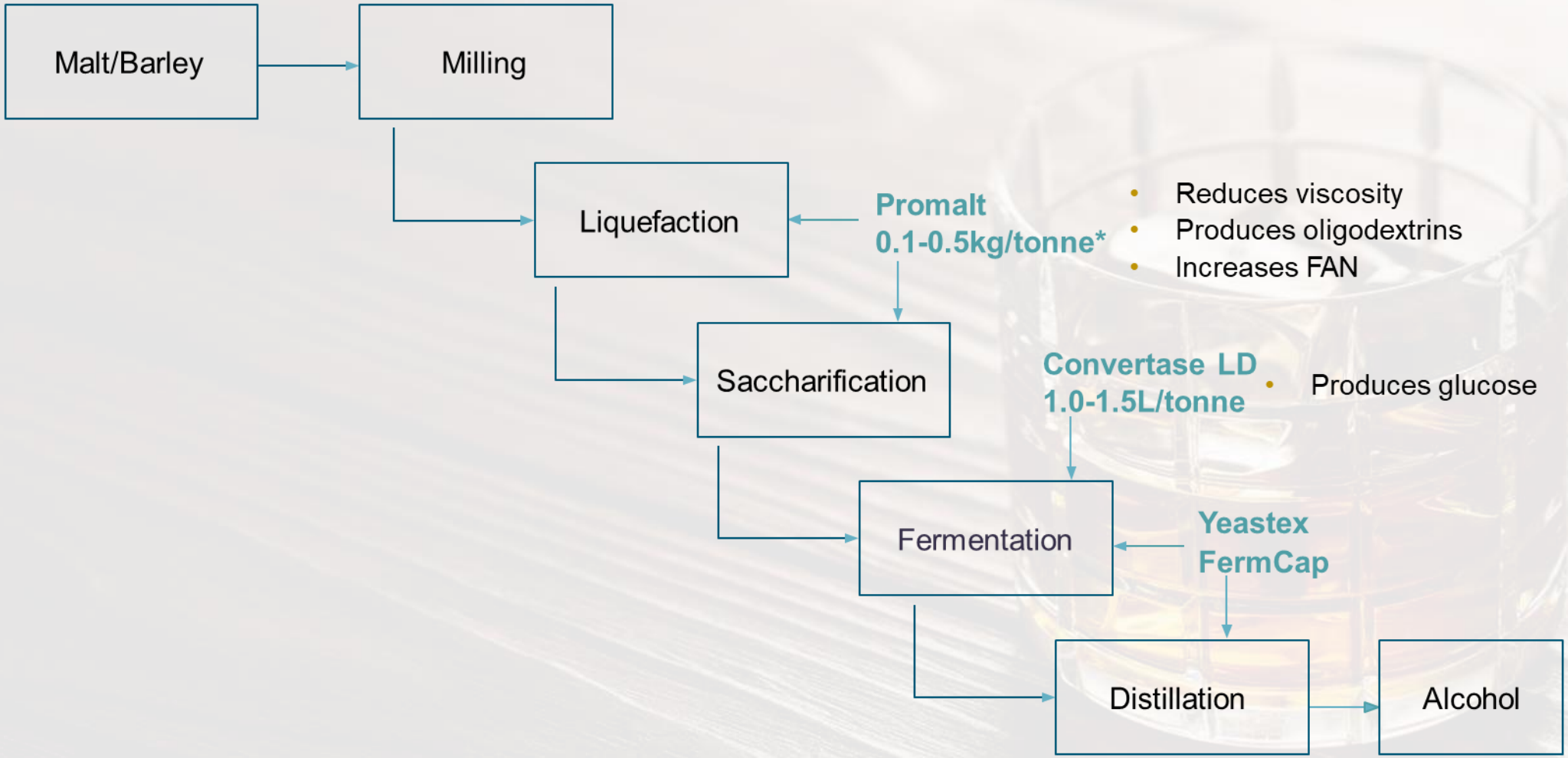
Wheat process yield optimization examples

Hitempase 500ml/t wheat.
Add Hitempase (500ml/tonne wheat) and raise mash to 90-100°C and hold for 20-30 min.
Cool to 30°C and add Amylo 300 (on wheat) and ferment for ~60 hours.

Amylo optimization:

Amylo 300 (g/tonne wheat)	**Alcohol yield** (L/tonne)
150	407.9
200	414.9
250	414.1

Enzymes for Malt/Barley Processing



* Dose rate on barley

Barley process yield optimization examples

25% barley brews

Enzyme	Dose (g/tonne)	Alcohol Yield (litres/tonne dry) 72 hr	Alcohol Yield (litres/tonne dry) 90 hr
Amylo 300	1,000	414.0	416.0
Amylo 300	850	415.0	415.9

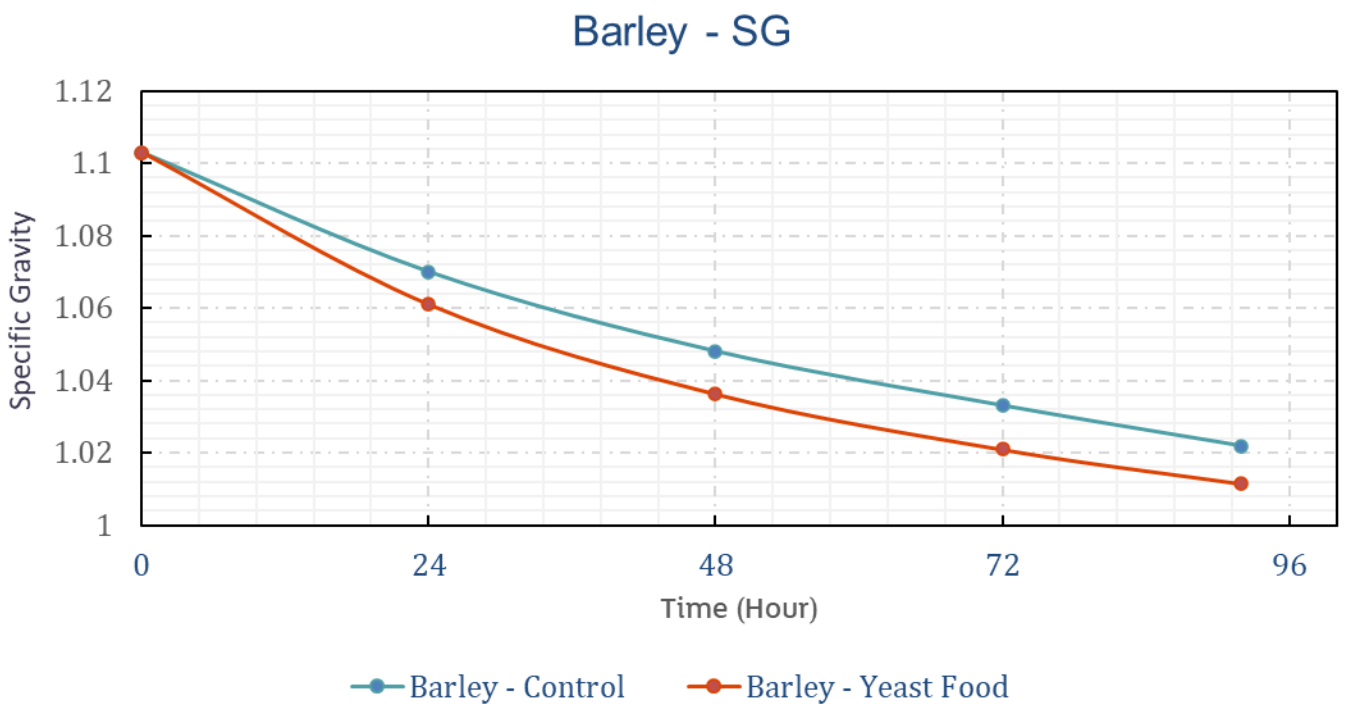
Hitempase (500 g/tonne), Bioprotease N100L (120 g/tonne) and Bioglucanase GB (130 g/tonne) were added to all brews

Yeast food solutions

Benefits

- Enhanced fermentation rate
- High assimilable nitrogen
- Lower cost-in-use

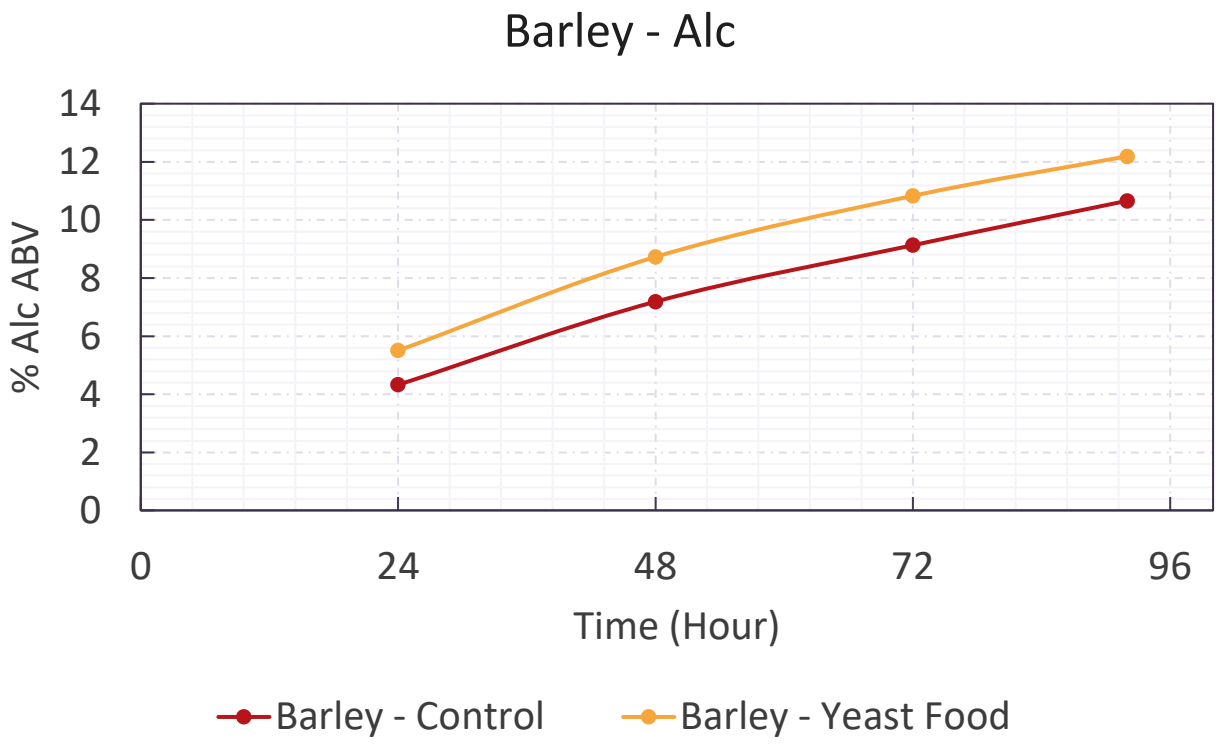
Reduce specific gravity in barley fermentation



Yeastex Trial Number 1

Yeastex speeds up fermentation and delivers higher LPAs

Increase % alcohol yield in barley fermentation



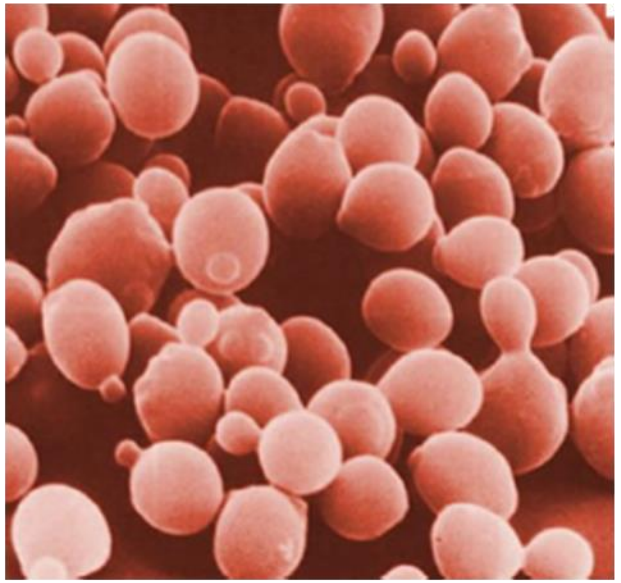
Yeastex Trial Number 1

Yeastex S speeds up fermentation and delivers higher LPAs

Yeastex™ | Blend of amino acids, minerals and vitamins

Improve process efficiency with yeast nutrients

Developed for brewing propagation & fermentations



Benefits

- Improved fermentation performance
- Increased yeast cell count
- Increased yeast viability/vitality
- Increased attenuation/alcohol yields

FermCap™ | Silicone-based antifoam

Improve process efficiency with anti-foam

Developed for brewing propagation & fermentations

Benefits

- Increased FV capacity: up to 7-15%
- Improved CO2 recovery
- Control over foaming in stills
- Optimization of CIP processes/cycles

Kerry Enzymes & Ingredients Distilling Portfolio

PRODUCT	AREA OF ADDITION	ENZYME ACTIVITY	FUNCTION	BENEFIT	GM STATUS
Promalt	Mash Vessel	Enzyme system	• Saccharification & viscosity reduction	• Improved extract yields/viscosity reduction • Improved free alpha amino nitrogen (FAAN)	Non-GM
Hitempase	Mash Vessel/Jet Cooker	Bacterial amylase	Liquefaction	• Improved extract yields, Reduce mash viscosity • Decrease effect of un-gelantinized/starch positive wort • Improve grist due to liquefication of adjuncts – maize, rice, sorghum	Non-GM
Bioprotease	Mash Vessel	Protease (Bacterial)	Fermentation	• Improved extract yields, Improved free alpha amino nitrogen (FAAN)	Non-GM
Bioglucanase GB	Mash Vessel/ Fermenter	Beta-glucanase	Filtration & viscosity reduction	• Improved mash filtration • Improve grist due to poor quality malt or low % barley adjunct	Non-GM
Convertase LD	Mash Vessel/ Fermenter	Glucoamyase	Saccharification	• Improve wort/wash fermentability • Improve wort fermentability	Non-GM
Amylo 300	Mash Vessel/ Fermenter	Glucoamylase	Saccharification		Non-GM
FermCap	Fermentation	Anti-foam	Fermentation	• Reduce foam during fermentation and distillation	Non-GM
Yeastex	Fermentation/yeast propagation	Yeast Nutrients	Fermentation	• Improve fermentation performance	Non-GM

Enzyme

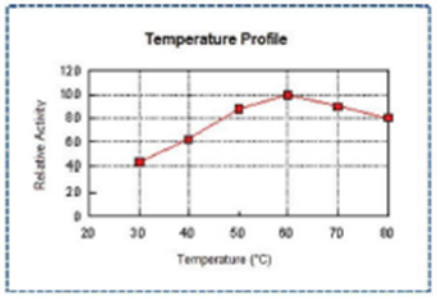
Brewing Ingredient

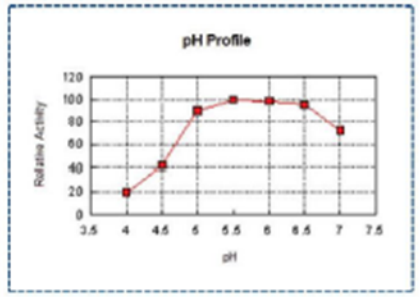
Bioglucanase® FS2000

Non-GM

Rye processing viscosity reduction

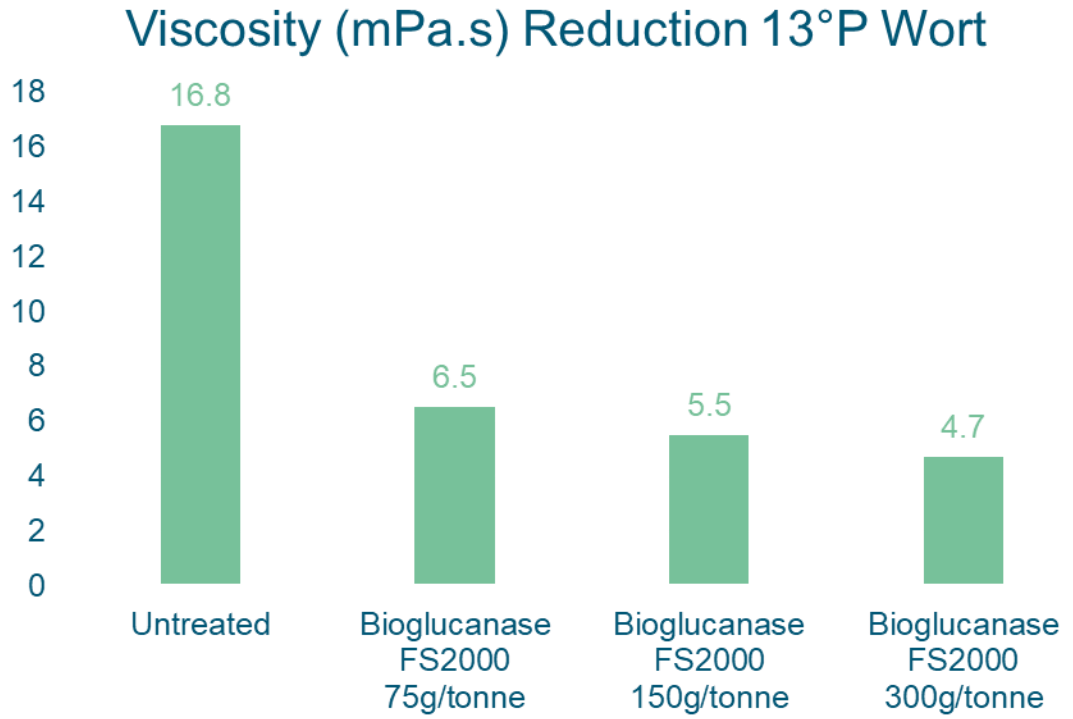
Bioglucanase FS2000 is a high temperature stable (>80°C) glucanase/cellulase/xylanase enzyme. It is very effective in high adjunct brewing, hydrolyzing non-starch polysaccharides (glucans and arabinoxylans) which can reduce brewhouse extract yield, mash and beer filtration.





Benefits

- Added during mashing of 100% rye grist
- Large reduction in viscosity
- Easier to process
- Faster filtration



Bioglucanase® GB

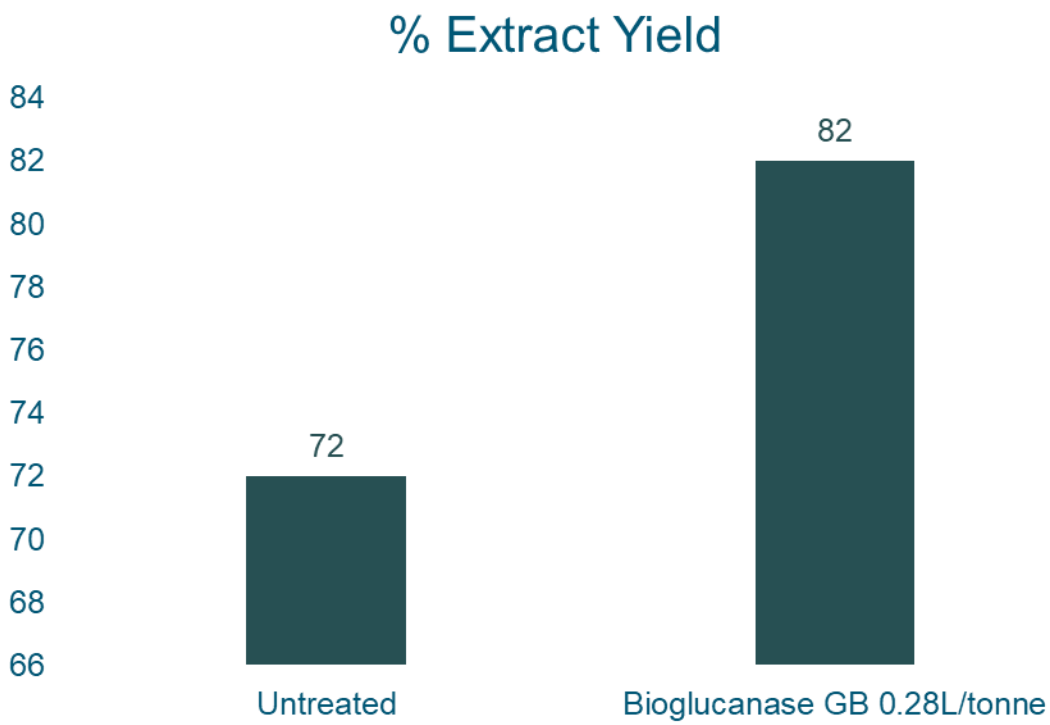
Non-GM

Optimize process by increasing extract yield

Bioglucanase GB is an enzyme preparation which contains cellulase, hemicellulase and betaglucanase activities. The activities present in Bioglucanase GB are effective in the degradation of the complex carbohydrates found in plant cell walls.

Benefits

- Added during mashing of malt grist
- Increase extract yield
- Reduction in viscosity
- Easier to process
- Faster filtration



Hitempase™

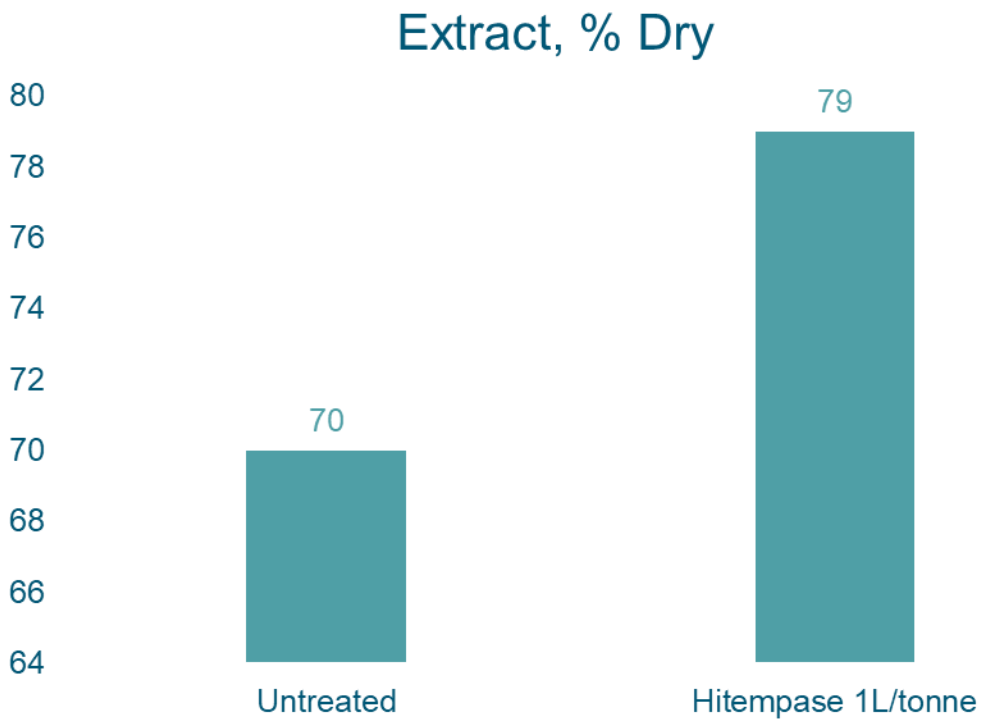
Non-GM

Increase extract yield by 13%

HITEMPASE is a heat stable endo alpha amylase used in the brewing industry for effective liquefaction of starch in high adjunct (barley, rice, maize , sorghum) brewing/distilling.

Benefits

- Thermostable amylase
- Increase in extract
- High temperature starch liquefaction
- Effective in mash conversion vessel with barley and/or cereal cooker with other adjuncts



Hitempase STXL added during mashing of 40% barley, 60% malt grist

Convertase™ LD

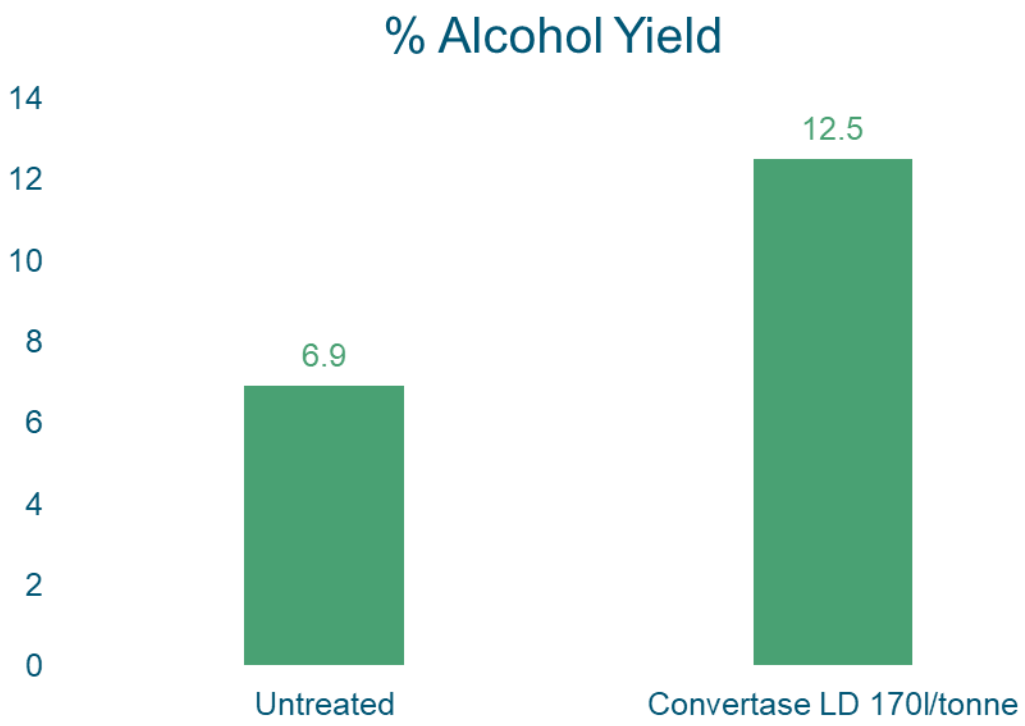
Non-GM

Increase alcohol yield by over 5%

Convertase LD is glucoamylase specifically developed to optimize alcohol yields in distillery fermentations by optimize glucose production in mash, wash and fermenter.

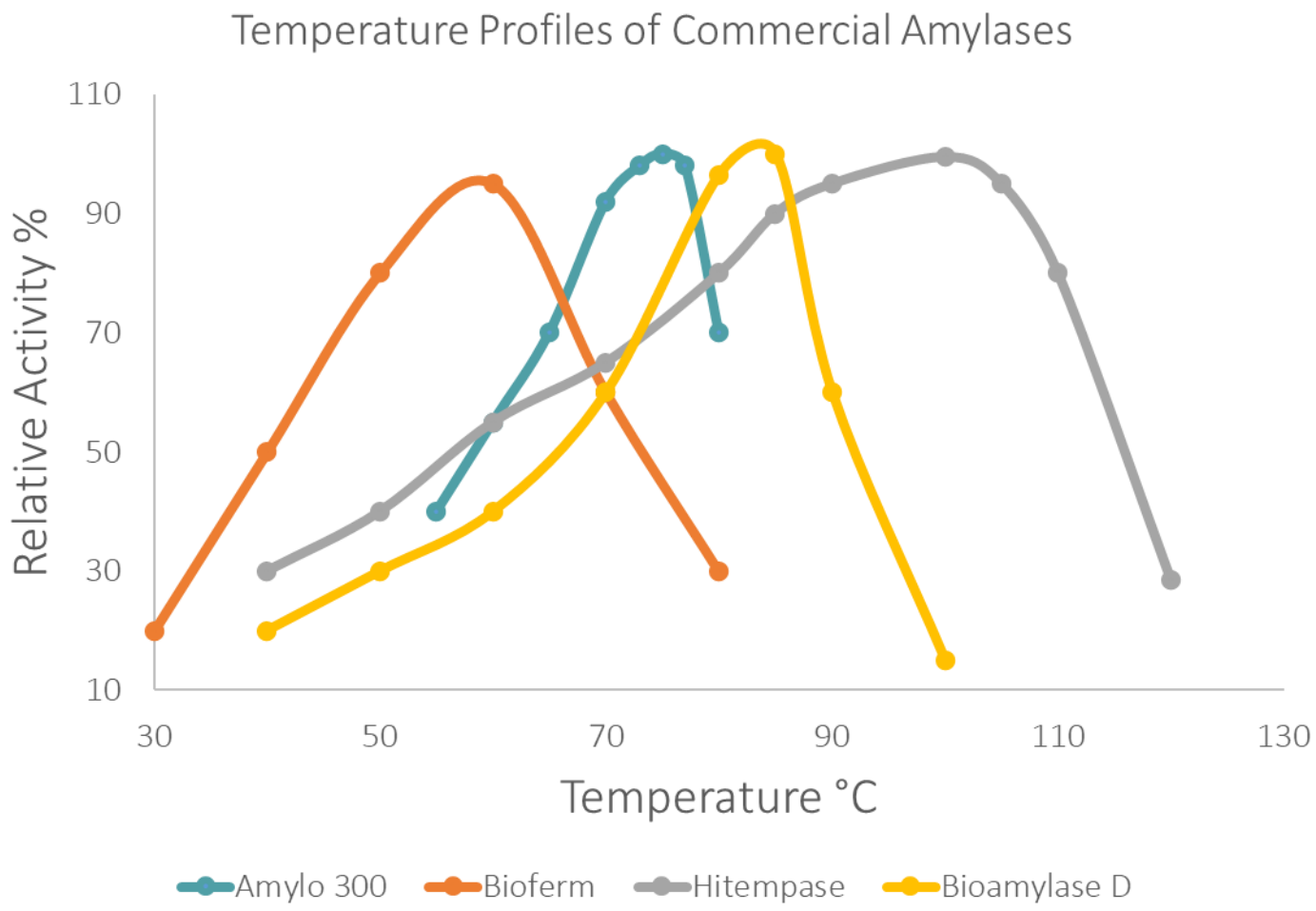
Benefits

- Increases fermentability
- Continues working during fermentation
- Delivers high alcohol potential



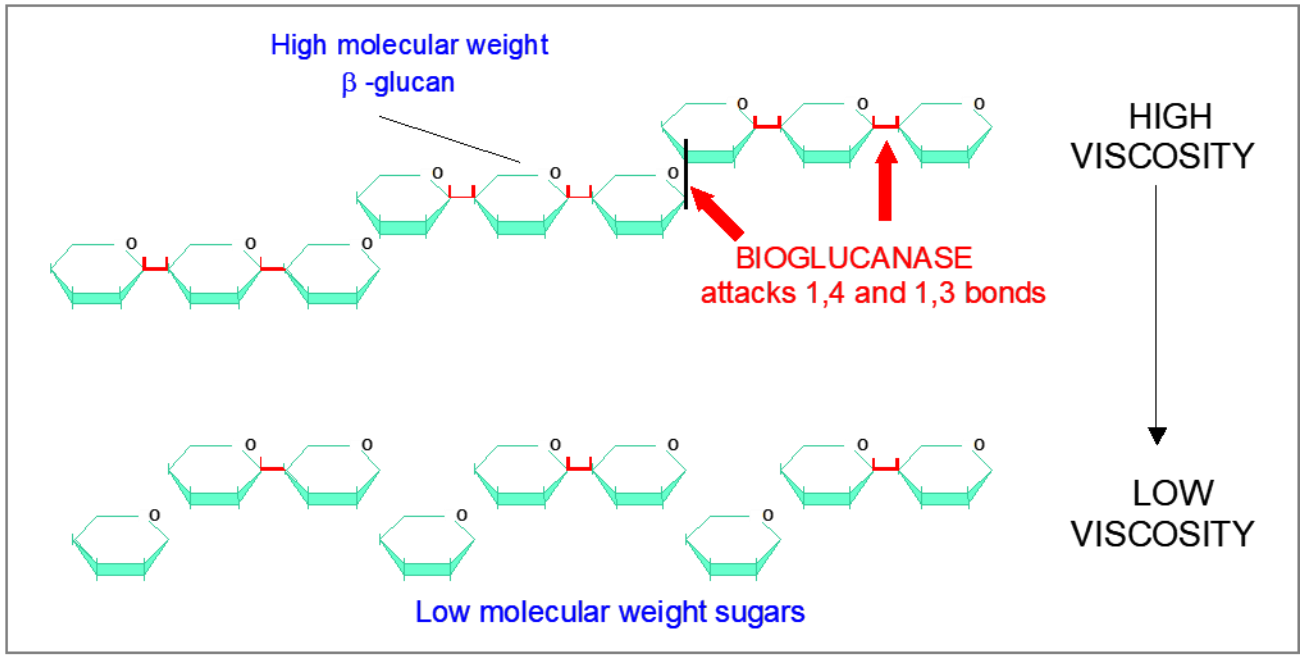
Convertase LD added to a mixed malt/barley mash during fermentation

Enzyme activity: Amylase temperature profiles



Improve filtration rates and extract yields with enzymes

- Variable malt quality, mash filtration and high wort viscosity
  Bioglucanase GB, Bioglucanase HAB, Bioglucanase FS2000, Promalt
- High adjunct barley
  Bioglucanase GB
- 100% Barley or rye combinations
  Bioglucanase HAB
- 100% wheat or Rye
  Bioglucanase FS2000
- High adjunct
  Promalt range (Amylase/Glucanase/Protease)



KERRY

Sustainable Solutions

Better Product

Better Process

Better Planet

Reduce Carbon Footprint & Energy Consumption

RAW MATERIAL

Enzymes and processing aids increase extract yield, improve hop utilisation, and filtration efficiency. This reduces the amount of grain, hops & kieselguhr used / hl beer

MANUFACTURING

Enzymes and processing aids save energy, water and reduce the use of cleaning chemicals

DISPOSAL

Clarification aids help reduce amount of Kieselguhr sent to landfill

Case Study: Reducing Carbon Footprint using Kerry Enzymes

Bioglucanase™ can help brewer's produce beer with **35% barley** instead of 100% malt, saving ~6,333 mt CO_2e per annum.*
That's the same as:

1.6 installed wind turbines

c14,500 barrels of oil

Energy use for one year for c.700 homes

*based on a 6m Hl p.a brewery

Why partner with us?

Our teams of master brewers/distillers, flavorists and enzyme experts take a holistic approach to help you:

1. **Complete portfolio for process optimization and product development**
2. **Provide technical support, improve process efficiencies & reduce cost**
3. **Expand on taste and flavors**
4. **Sustainability benefits & reduce energy consumption**

KERRY

Enzyme Experts

Thank you.