NEER™

A flavor enhancing brewing solution for non-alcoholic beer, NEER™ is a unique yeast concept that only requires your pure brewing skills

NEER™ is frozen *Pichia kluyveri* for direct inoculation that produces <0.5% alcohol only from monosaccharides

Fermentation characteristics

- Enhanced fruit flavors: high production of esters and thiols without diacetyl
- Medium production of polysaccharides
- Low ethanol production
- Low pH drop

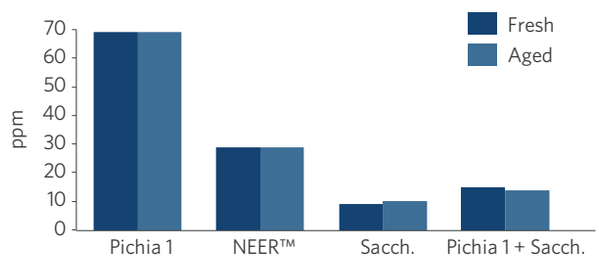
Main benefits of NEER™

- Flavorful compounds from the specially isolated and selected *Pichia kluyveri* strain
- No propagation equipment or slant procedures required – direct inoculation
- Frozen concept means that NEER™ is always ready when you need it

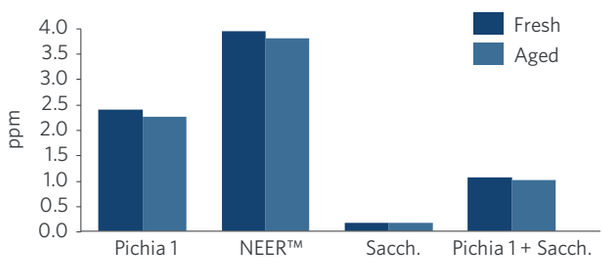
Application

Dosage	1000u (1kg) for 500hl.
Plato	Aim for 8-9 Plato wort with ~10g/L monosaccharides. Alternatively opt for high gravity brewing (12-14 Plato) and dilute.
Additions	Tannic acid (Brewtan B) should be added during mashing and boiling. CO_2 stripping is an alternative to remove sulfuric notes after the fermentation step.
Fermentation	16-22°C / 61-71°F (18°C / 65°F is optimal).
pH	NEER™ decreases pH only by 0.1-0.4 on average - pH adjustments are required.
Mixing of fermentation	NEER™ is not a vigorous fermenter. Content of tank should be mixed throughout the fermentation. Mixing speed should be set to turnover the tank within 8 hours.
Oxygenation	> 8-10 ppm oxygen for tanks < 25 hl. Extra oxygenation might be needed for larger tanks.
Fermentation time	Until monosaccharides are completely consumed or 0.4% ethanol is reached (depending on rate of cooling, it takes approx. 3-5 days).
Cooling	As NEER™ will ferment down to at least 15°C, fast cooling is recommended.
Maturation	Short maturation for protein stability only.
Centrifugation	Recommended as yeast does not flocculate. Alternatively, filtration is an option.
Bottling	Alcohol free beer contains residual sugars. We recommend implementation of high QC standards to prevent microbial contamination during bottling.

Ethyl acetate



Isoamyl acetate



NEER™
Pichia kluyveri for production of non-alcoholic beer

Introduction

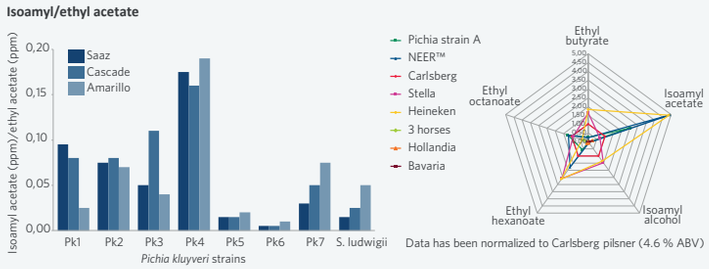
Due to increased consumer awareness and a desire to live healthier, the global beer market is experiencing a large increase in sales of low- (< 3.5 % ABV), and non-alcoholic beers (< 0.5 % ABV), especially during the last 5 years. However, most non-alcoholic beers suffer from inferior organoleptic properties due to the 'side-effects' of the physical removal of ethanol or the application of cold-contact with regular brewers' yeasts. We here present a TRUE brewing solution, NEER™, for the production of full bodied, flavorful, non-alcoholic beers, based on the application of our patented *Pichia kluyveri* strain. NEER™ offers a low CAPEX and OPEX alternative compared to the newer technical methods for production of non-alcoholic beers, e.g. membrane removal of ethanol. Furthermore, NEER™ is sold in a direct pitch format, hereby circumventing the need for propagation. NEER™ is, to our knowledge, the only yeast for production of non-alcoholic beers sold in this convenient format.

P. kluyveri isolation and characterization

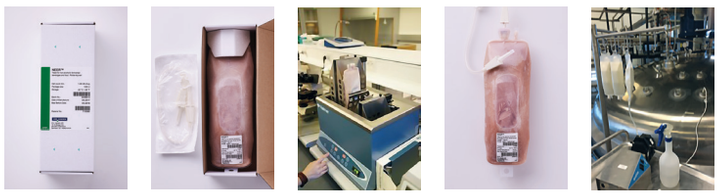
A large array of *P. kluyveri* strains were screened based on the following criteria:

- Maltose negative strains
- No/very low alcohol production
- High level of esters
- No off-flavor production
- Tolerate hop compounds
- Low to moderate oxygen demands

Subsequently, the 7 best candidates were tested for their ester production capabilities in combination with 3 different hop varieties. From this experiment (bar plot) the best *P. kluyveri* strain (Pk4 -> NEER™) was selected. When this strain was tested in a standard pilsner wort, it produced a beer with a positive flavor profile (spider web plot).



From freezer to fermentor in 1 hour



NEER™ concept

NEER™ is produced using Chr. Hansen's proprietary production method which ensures high product performance, consistency and low risk of contamination. The NEER™ product is delivered on dry-ice as a 1 kg frozen block that after thawing can be transferred to the fermentation vessel using the sterile connection tube included in the package. NEER™ is highly concentrated and 1 bag (1 kg) can be used to inoculate 500 hL of wort and normally finishes fermentation within 3-5 days. Minimal maturation of the beer is required.

Brewing process comparison

Compared to a regular brewing process, NEER™ can substitute brewers' yeast without having to make significant changes to the process. NEER™ only assimilates monosaccharides and as a result some adjustments have to be made:

- The fermentation tank needs to be mixed as lower level of produced CO_2 limits fluid motion in the tank.
- The mashing regime and malt utilization needs to be tuned so the resulting wort has ~10 g/L monosaccharides content. Higher monosaccharide levels can be used, but then the fermentation needs to be stopped by cooling to avoid overshooting 0.5 % ABV or a subsequent dilution step with de-aerated water implemented. The extend of the respiratory phase also influences the final alcohol level.
- Due to the residual oligosaccharides in the final beer, high QC standards or bottle pasteurization have to be implemented.

NEER™ has been demonstrated to be applicable for producing non-alcohol version of almost any beer style.

	Pre-fermentation		Fermentation	Post-fermentation
Trad. full alc. beer	Propagation	Mashing, lautering, boiling, whirlpooling	Low/high gravity fermentation	Maturation, filtering, bottling
NEER™ beer	✖		Direct inoculation of *P. kluyveri*	Centrifugation or filtration, bottling
Trad. low alc. beer	Propagation		Interrupted or halted fermentation	Physical removal of alcohol

"The Pichia trial we did at our end produced some fantastic ester aromas and really helped to kill off the awful wort character of typical N/A beer"

- Verified customer quote

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