NEW TOOLS FOR NON ALCOHOLIC BEER PRODUCTION

WE BREW WITH YOU®

KYLE SOMERS – LALLEMAND BREWING– TECHNICAL SALES MANAGER
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CBC PHILADELPHIA – APRIL 2026

SCOTT LABORATORIES

PROUD PARTNERS OF

LALLEMAND

LALLEMAND BREWING

WHO WE ARE

A trusted partner for more than 90 years

SCOTT LABORATORIES IS A LEADING SUPPLIER FOR THE NORTH AMERICAN WINE, BEER, CIDER, AND SPECIALTY BEVERAGE INDUSTRIES. OUR DEEP INDUSTRY ROOTS DATE BACK TO OUR FOUNDING AS THE BERKELEY YEAST LABORATORY 1933. TODAY, WE PRIMARILY SUPPORT THE BEER INDUSTRY WITH FILTRATION AND STABILIZATION.

OUR VALUES

Education, honesty, and doing the right thing.

WHO WE ARE

LALLEMAND IS A PRIVATELY-HELD CANADIAN COMPANY THAT SPECIALIZES IN THE DEVELOPMENT, PRODUCTION, AND MARKETING OF YEASTS, BACTERIA, AND THEIR DERIVATIVES.

Lallemand provides microbiological solutions for dozens of different industries and is organized into 11 technically-driven business units focused on various yeast and bacteria applications.

Lallemand has a proprietary bank of yeast and bacteria that includes thousands of genetically-identified strains. With the goal of reproducing, managing, and optimizing natural fermentation processes, Lallemand can offer their customers not only the precise microorganism or derivative that fits their unique needs, but also the support, knowledge, and expertise that comes with over a hundred years of continuous research in this field.

INTRODUCING YOUR SPEAKER

Kyle Somers (he/him) - Technical Sales Manager for California and the Western US

Current President of the Northern California district of the Master Brewers Association.

Holds an International Brewing Diploma from Siebel Institute of Technology in Chicago and Doemens Academy in Munich.

Ten years of hands-on production brewing experience prior to joining the Lallemand team in 2019, including stints with Firestone Walker, Lagunitas, and Hen House Brewing.

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WHY CONSIDER NA BEER PRODUCTION?

METHODS OF NA BEER PRODUCTION

RECIPE DESIGN AND PROCESS CONSIDERATIONS

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NA BEER PRESENTS OPPORTUNITY FOR GROWTH

49% of American are trying to drink less in 2025[1]

- Gen Z: 65%
- Gen Y: 57%
- Gen X: 49%
- Boomers: 30%

22% prefer NA Beer to NA Liquor (10%) or NA Wine (13%)[2]

1 NC Solutions Consumer Sentiment Survey January 2025
2 Beer Institute Consumer Poll January 2025

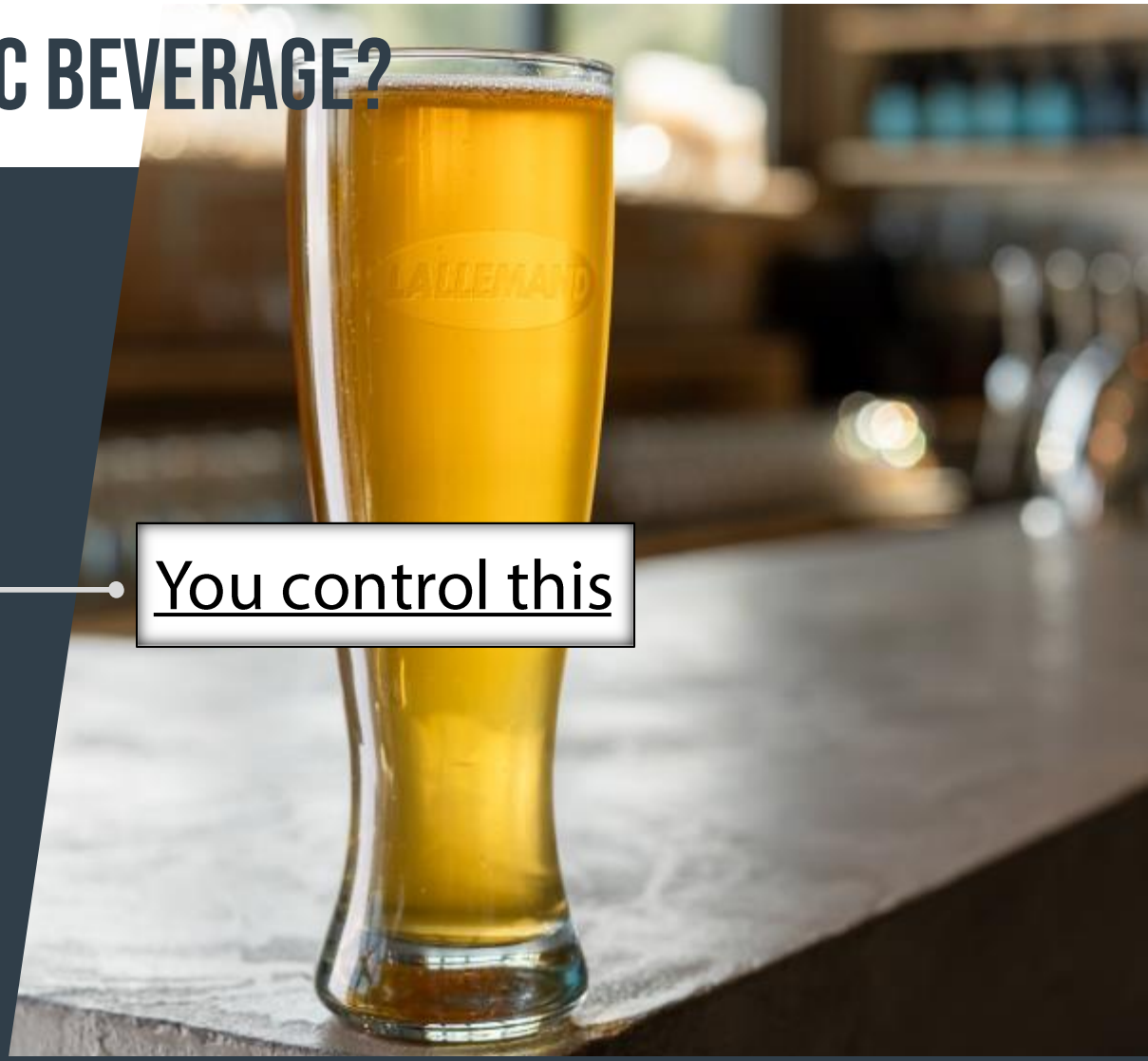
WHAT DO CONSUMERS MISS IN A NON-ALC BEVERAGE?

43% Mood-Enhancing Effects

39% Flavor

30% Variety of Choice

28% Sociability



1 Veylinx consumer study 2022

PRODUCTION OPTIONS

Thermal & Evaporative

Rectification, spinning cone, vacuum distillation, etc.

Pros:

- 0.0% possible, Complete fermentation process, ethanol for alternative beverages

Cons:

- Flavor degradation, energy cost, equipment CapX, additional license

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PRODUCTION OPTIONS

Reverse Osmosis & Membrane Filtration

Removal through semi-permeable membrane

Pros:

- 0.0% possible, Complete fermentation process

Cons:

- Flavor loss, energy cost, equipment CapX, high water usage

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PRODUCTION OPTIONS

Arrested Fermentation

Shortened contact time, cold contact

Pros:

Low capital, minimal/no flavor degradation

Cons:

Can overshoot alc targets, worty off-flavors, stability concerns of residual sugars

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PRODUCTION OPTIONS

Limited Fermentation

Low wort fermentability, Maltose/Maltotriose negative strains

Pros:

Low/no capital expenditure, no flavor degradation, low energy use

Cons:

Worty off-flavors, stability concerns of residual sugars

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LIMITED FERMENTATION OPTIONS

- Non-Saccharomyces
  - Pichia, Torulaspora Delbrueckii, Candida Spandovensis, etc
  - Varying degrees of maltose utilization, may require special handling
- Saccharomyces Variants
  - Saccharomyces Cerevisiae v. Chevaliari, Saccharomyces ludwigii
  - Typically POF+, Can produce flavor compounds at levels inconsistent with consumer expectations

LIMITED FERMENTATION OPTIONS

- Maltotriose Negative Strains

  Typically English origin ale strains.

  Leaves fewer residual sugars, provides typical beer flavor/aroma

  Usually requires significant watering back to stay below .5% alcohol limit

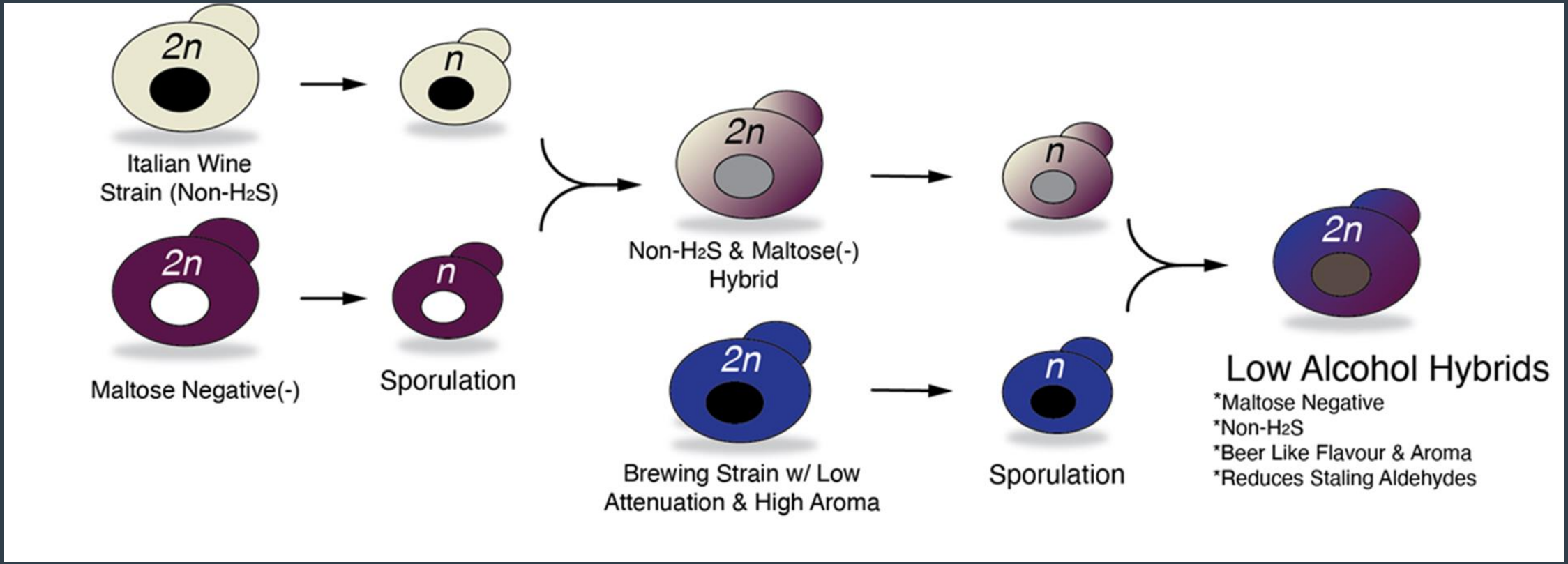
- Modified Saccharomyces – Maltose negative

  GMO/Hybridized to be incapable of fermenting maltose

  Provides typical beer flavor/aroma, minimal/no watering back

  Less shelf stable due to residual sugars, GMO products not allowed in certain markets

THE FUTURE IS HYBRIDIZED YEAST



RECIPE AND PROCESS CONSIDERATIONS

Limited Fermentation

Malt Bill:

- Crystal/caramel malts can increase oxidative character
- Avoid highly kilned malts
- Consider LOX-less malt
- Use mouthfeel enhancing malt, foam positive malts

Degree of Fermentation:

- OG at 5-8P (1.020-1.032)
- Lower gravity allows for higher RDF
- Target RDF of 10-25%

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HIGH TEMPERATURE MASHING

High Mash Temps to promote

alpha amylase activity & denature beta amylase

- Low water-to-grist ratio
- Short/No Mash hold

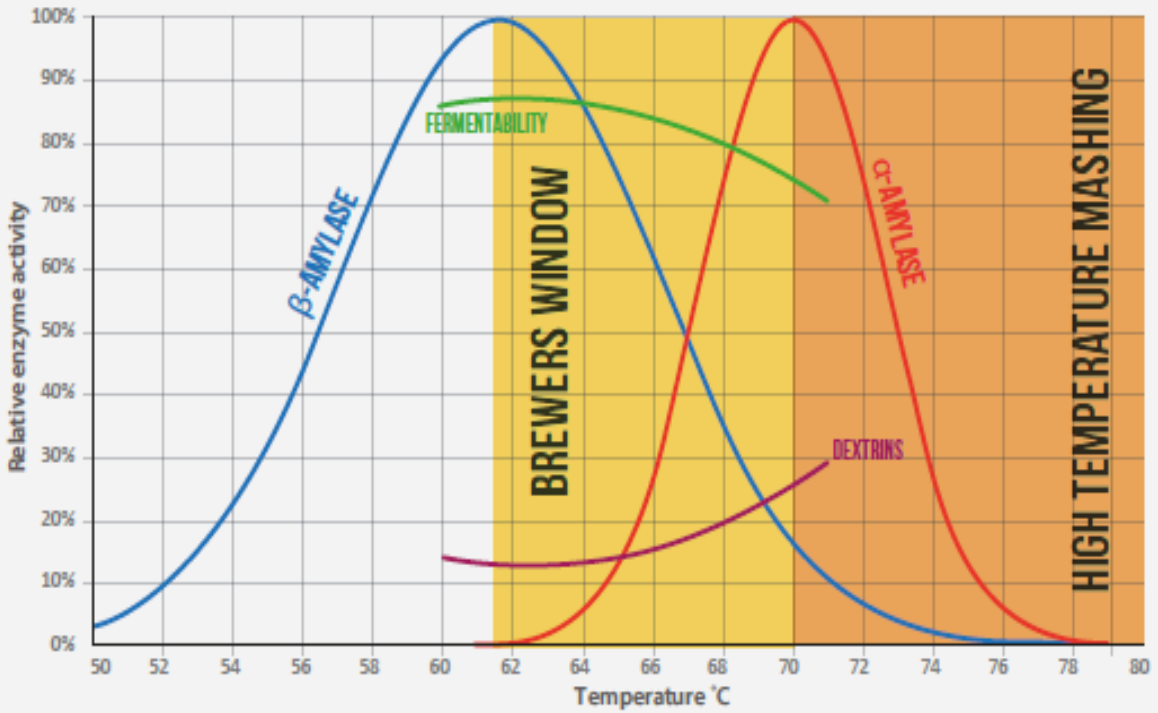
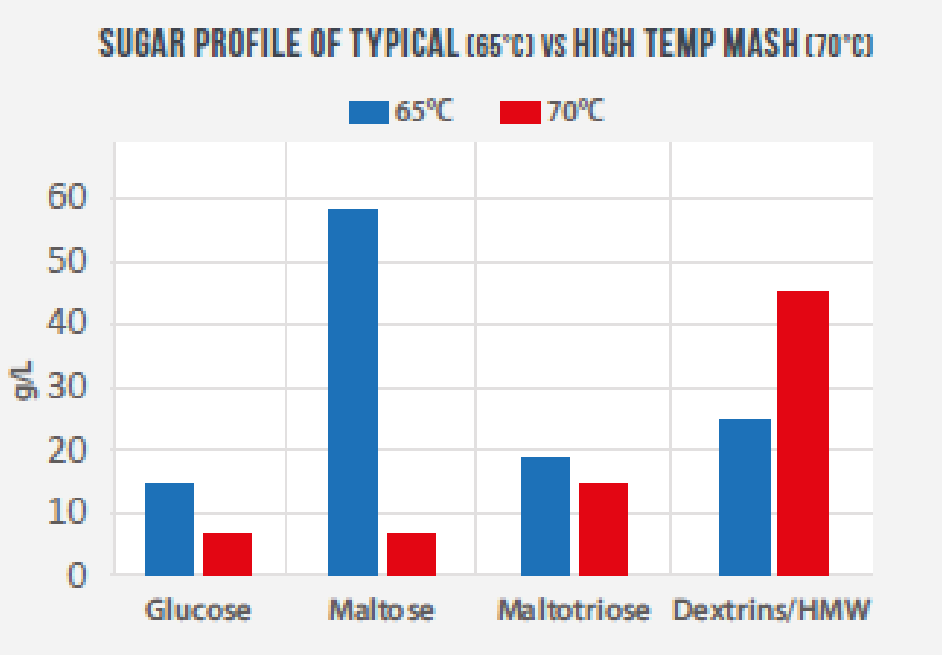
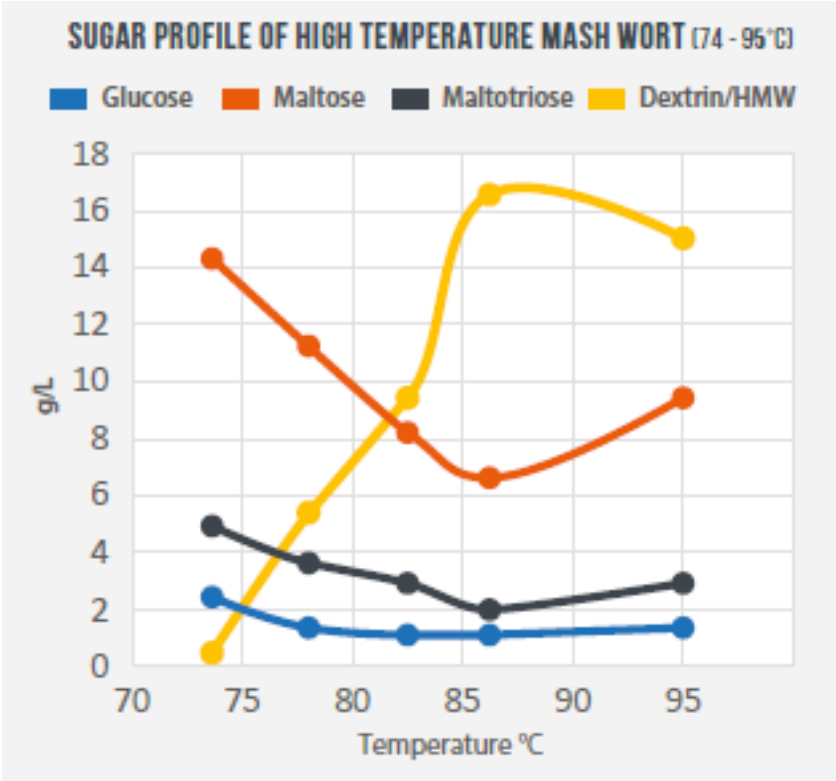


FIG. 2: Different types of enzymes have different specific activities during mash conversion that influence the composition of fermentable and non-fermentable sugars in the wort.

EFFECTS OF TEMPERATURE OF SUGAR COMPOSITION

Mash Temperatures and their relative sugar compositions





DEGREE OF FERMENTATION

Lower (10%) **Real Degree of Fermentation (RDF)** **Higher (25%)**

Lower Alcohol Production	Higher Alcohol Production
Worty	Lower levels of aldehydes
Lack of expected desirable compounds	Increased production of sulfur and esters
More residual sugar	Less residual sugar
No/low dilution required	Increased need for dilution

THE FUTURE IS INACTIVATED YEAST

ISY Enhance – the Body Builder

- Inactivated yeast loaded with mannoproteins and polysaccharides to help with body and mouthfeel
- Low cost alternative to maltodextrin

RECIPE AND PROCESS CONSIDERATIONS

Limited Fermentation

Hops:

- Hotside additions can be used as normal, but start w/ reduced bitterness
- Consider alternatives to cone or pellets for cold side additions

Cellar:

- Reduce and minimize touches to limit microbial contamination
- Minimize any hold times in tank

THE FUTURE IS YEAST DERIVED

YOPS

- Yeast derived hop flavors, Non-GMO final product
- Produced by Evodia, available through Lallemand/Scott Labs
- Easy to mix and dose
- Low dose rates
- Variety of natural flavors available

RECIPE AND PROCESS CONSIDERATIONS

Limited Fermentation

What can I control?

- Bitterness
- Acidity/pH
- Carbonation
- Mouthfeel/body
- Degree of Fermentation
- Amount of fermentable sugars

BALANCE!

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PATHOGEN CONSIDERATIONS

Gram + Bacteria are low concern in beer due to presence of hop acids, but still a concern in alternative beverages

- Listeria is cold tolerant
- Botulism is mitigated below 4.6pH unless in a high protein substrate

Gram – Bacteria are the biggest concern

- E. coli and Salmonella most common bacteria responsible for food borne illness in the US

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PATHOGEN CONSIDERATIONS

Microbial contamination in beverage manufacturing facilities originates from raw materials, equipment, or packaging, and poor worker hygiene

(Kregiel, 2015)

E. coli and *S. enterica* grew and survived in low and nonalcoholic beers for over 2 months when stored at 4 and 14°C.

Previous work shows that when beer is stored at room temperature or 25°C, foodborne pathogens are able to grow to maximum density within a few days

(Menz et al., 2010)

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PATHOGENS – EFFECT OF ETHANOL

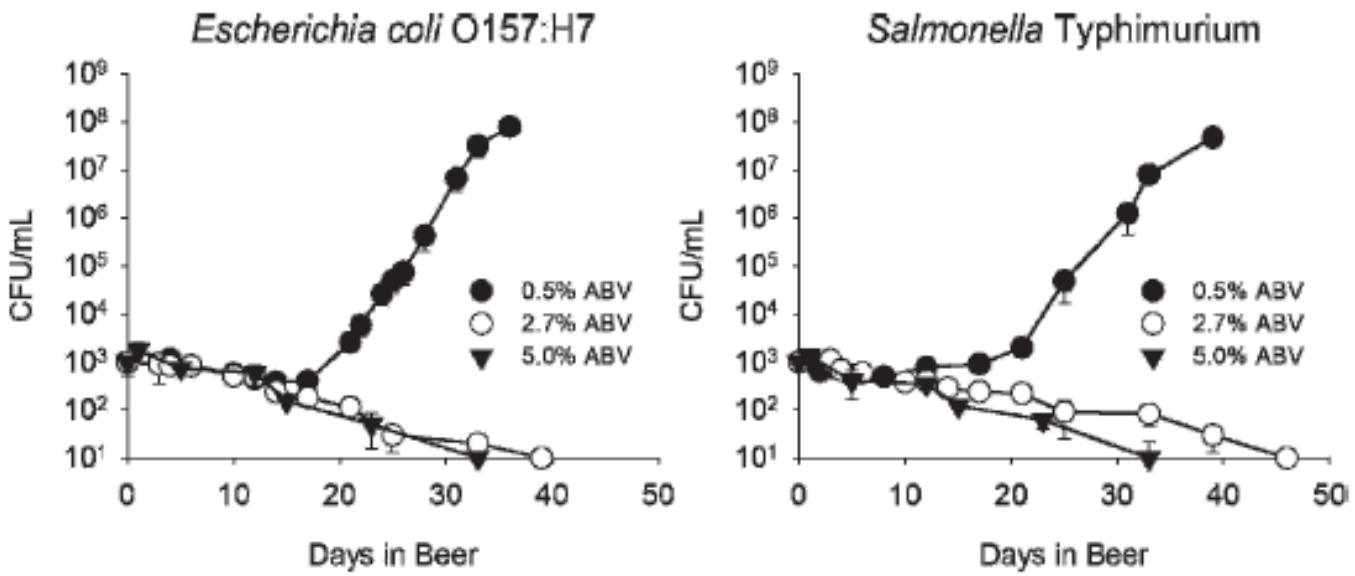


FIGURE 4. *Effects of ethanol on the survival of* E. coli *O157:H7 and* Salmonella *Typhimurium at 14°C, using alcohol-free beer (0.5% ABV) as a basal medium. Data points are the means of triplicate flasks; error bars are ±standard deviations.*

Menz et al 2011

PATHOGENS – EFFECT OF PH

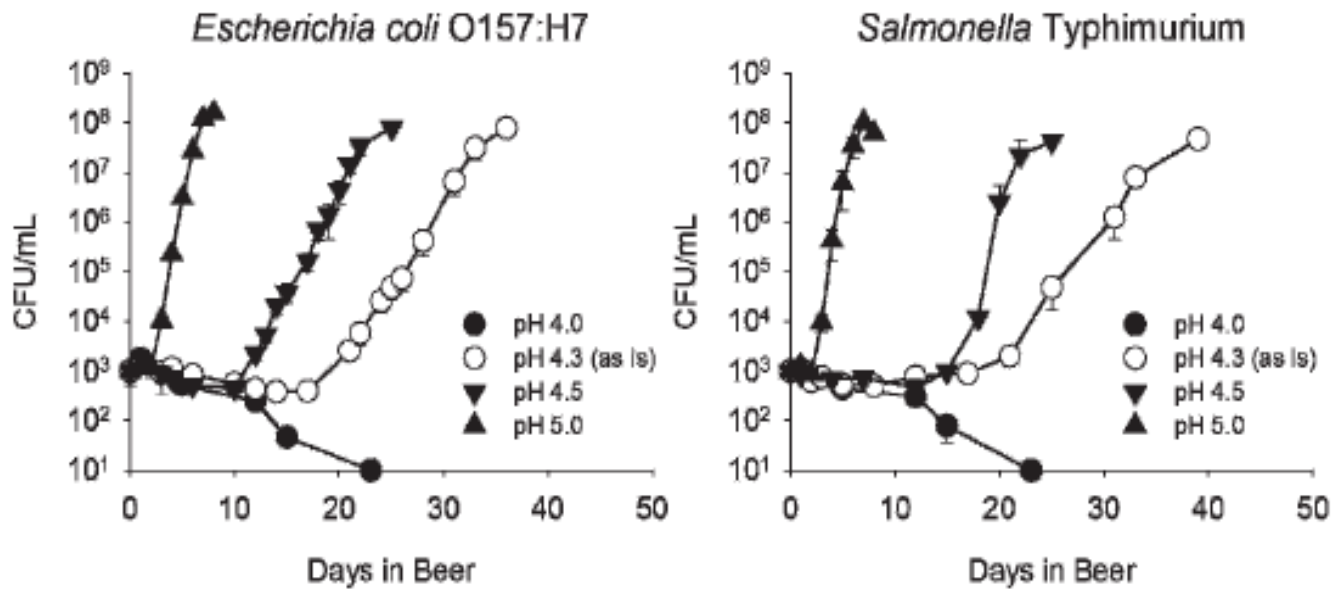
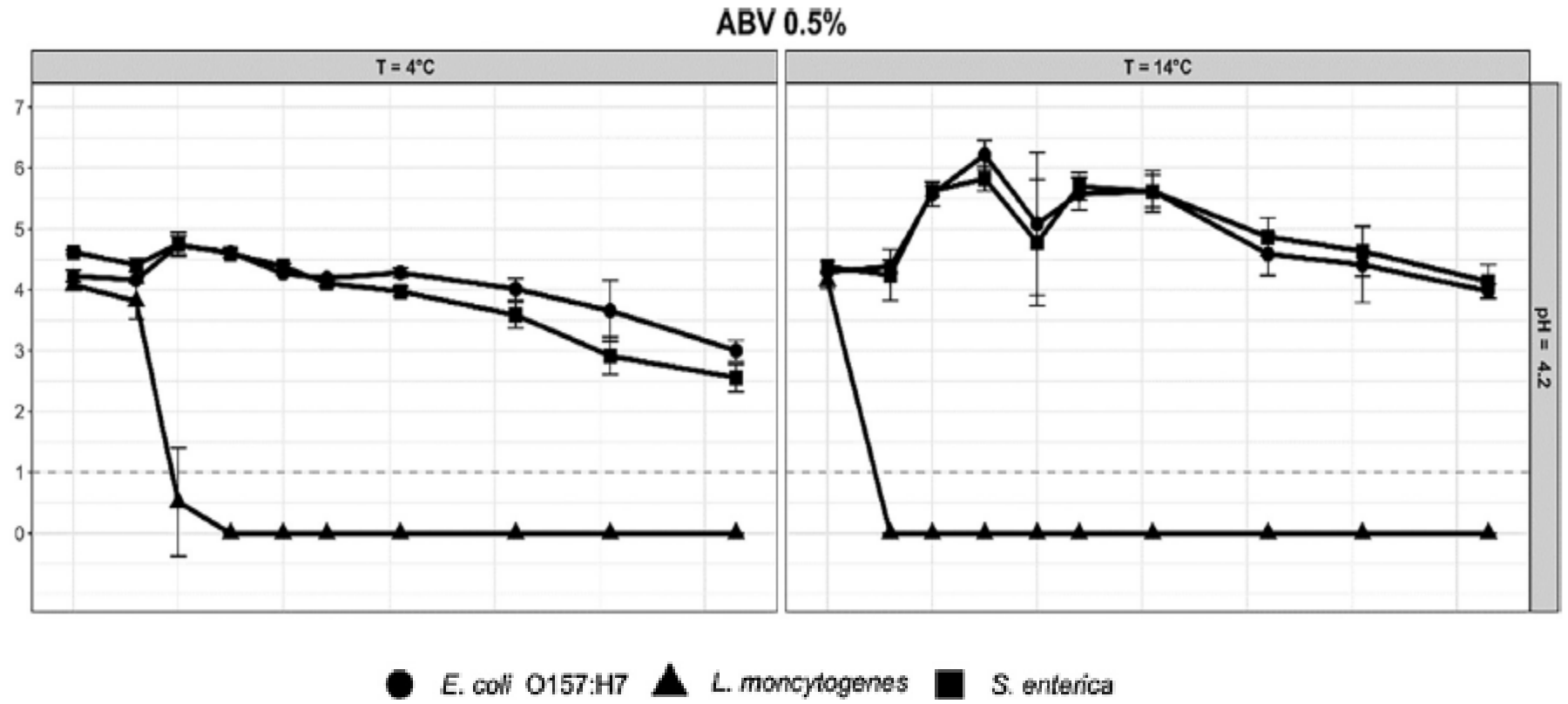


FIGURE 5. *Effects of pH on the survival of* E. coli *O157:H7 and* Salmonella *Typhimurium at 14°C, using alcohol-free beer as a basal medium. Data points are the means of triplicate flasks; error bars are ±standard deviations.*

PATHOGENS – EFFECT OF TEMPERATURE



Stabilization

01 Purpose

02 Methods of Stabilization

03 Putting It All Together

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01 Purpose

Purpose

As we move away from producing traditional beer (stable) we need to keep in mind **food safety** and **food quality** throughout shelf life

First, we must ensure that the product that we produce and distribute into the market is free of **pathogens**

Second, we must ensure that the product is protected from **spoilage organisms**

Purpose

Process Controls

- In addition to the standard methods of stabilization, there are things we can do in the brewery, upstream of packaging, to set us up for success
  - Sanitation – minimizing risk of secondary contamination
  - pH – controlling the brewing process and ingredient selection to ensure that the equilibrium pH of your NA beer is <4.2

Regulatory Compliance

Non-alc Beverage Production

Non-Alcoholic beer bears a **pathogen risk** that alcoholic beverages do not

- Working with a **Process Authority (PA)** is recommended
- A PA a liaison between your production facility and the government
- They assure microbiological safety in the production of food and beverages
- They evaluate beverage ingredients and beverage specs and issue a **Scheduled Process** to be followed to ensure that the beverage that is produced is safe

02 Methods of Stabilization

Methods of Stabilization

- Filtration
- Batch Pasteurizer
- Chemical Preservatives
- Tunnel Pasteurizer
- Flash Pasteurizer/ HTST
- Nagardo®

Methods of Stabilization

Solids Separation

Pros:

- Good first step in clarifying product and removing bulk solids

Cons:

- May not be sufficient as a control step for pathogen removal
- Does not provide protection downstream of process

Methods of Stabilization

Tunnel Pasteurizer

Pros:

- Addresses both food safety and food quality concerns in high acid beverages

Cons:

- Large capital investment
- Large footprint
- High energy demand
- Possible sensory impact to finished product
- Limits CO2 volumes in product

Methods of Stabilization

Batch Pasteurizer

Pros:

- Addresses both food safety and food quality concerns in high acid beverages
- Can be a good entry point to in container pasteurization and/or proof of concept

Cons:

- Very labor intensive
- Often the process is not in line with packaging
- Usually the limiting factor for production capacity
- Possible sensory impact to finished product
- Limits CO2 volumes in product

Methods of Stabilization

Flash Pasteurizer/HTST

Pros:

- Addresses food safety – control point for pathogens
- Small footprint
- Better for product quality than in container pasteurization
- Can be separated from the packaging process

Cons:

- Possible sensory impact to finished product
- Does not provide protection downstream of process

Methods of Stabilization

Persistent Preservatives:

SO_2, Potassium Sorbate, Sodium Benzoate

Pros:

- Addresses food quality concerns in high acid beverages
- Limits the growth of micro in product during and after production
- Inexpensive
- Easy to add to product

Cons:

- Does not necessarily kill micro
- Requires labeling
- Some consumer/retailer pushback
- Possible sensory impact to finished product

Nagardo®

Non-alcoholic beer is very sensitive to microbiological spoilage - Nagardo® provides natural protection

- Combination of sugar residues and no/low alcohol is an ideal environment for **yeast growth** which can lead to

  0.0% Alcohol generation → regulatory issues

  CO_2 generation → bottle bursting

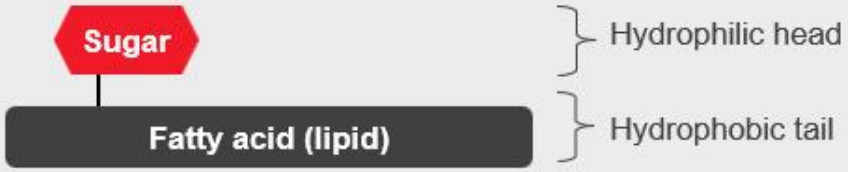
  Sensory defects → consumer disappointment

- Relevant for all packaging, but **kegs** are especially sensitive once on draft
- Nagardo® delivers persistent protections

Nagardo® provides natural protection for non-alcoholic beers

Natural glycolipids derived from a mushroom

- We found the perfect antimicrobial protection for non-alcoholic beer, invented by a tropical mushroom:



- Source organism is a wild type edible mushroom
- Like in a brewing process, glycolipids are produced by fermentation

Source organism of Nagardo®: Sweet Osmanthus Ear (*Dacryopinax spathularia*)

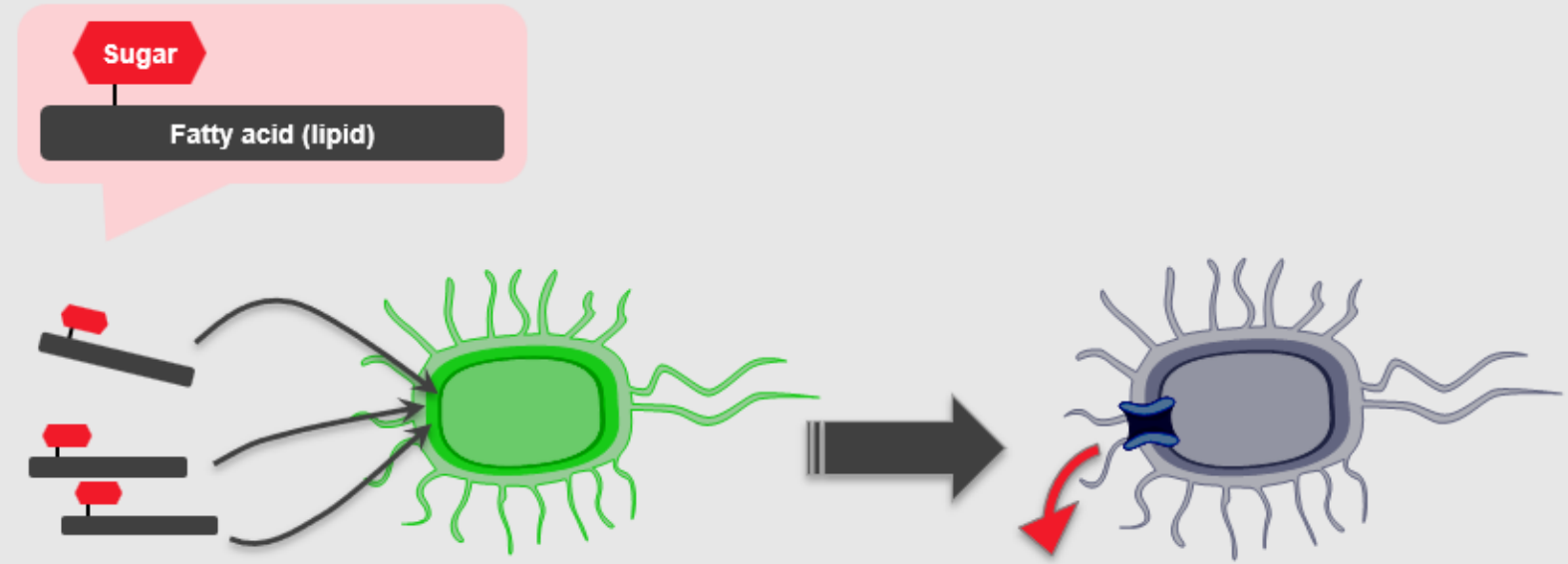
Natural protection by food grade production process, fully certified

Sustainable production by fermentation

- Based on **renewable resources** (glucose, yeast extract)
- **Non-GMO** production strain (wild type)
- **No chemical modification** of the natural glycolipids
- Constant quality of each batch by unique and strict process control
- Solvent-free
- No addition of excipients or any other components
- Food certified (FSSC 22000, Kosher, Halal)*

Nagardo® mode of action

- Nagardo® glycolipids are **amphoteric compounds**, interacting with microbial membranes.
- Defect membranes lead to loss of ATP etc. → microbial cells die.
- Specific molecular recognition assumed to explain high potency.
- No cross-resistance to any other preservative like benzoate or sorbate.



Natural glycolipids

Microbial cell

Microbial cells are killed by membrane permeabilization and leakage, as measured e.g. by ATP efflux and propidium iodide uptake.

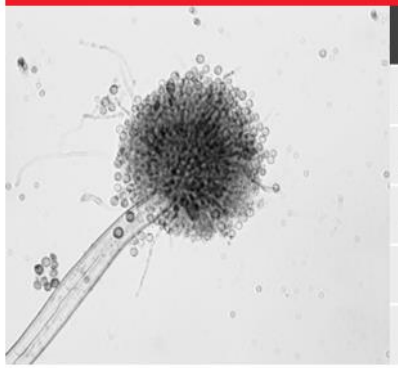
Nagardo® natural glycolipids act by disintegration of microbial membranes.

Highly effective against spoilage microorganisms

Yeasts

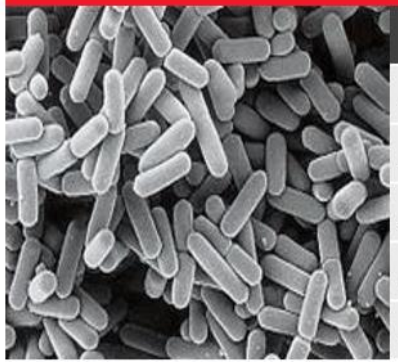
Organism	MIC Nagardo® [mg/l]
Saccharomyces cerevisiae	***3.1***
Zygosaccharomyces bailii	***3.1***
Zygosaccharomyces rouxii	***6.3***
Zygosaccharomyces bisporus	***15.6***
Candida parapsilosis	*6.3*
Dekkera (Brettanomyces) bruxellensis	***6.3***
Dekkera (Brettanomyces) naardenensis	***<3.9***
Rhodutorula mucaliginosa	*<10*

Moulds



Organism	MIC [mg/l]
Aspergillus brasiliensis	*6.3*
Byssochlamys nivea	*12.5*
Penicillium roqueforti	*12.5*
Talaromyces luteus	*3.9*
Trichoderma virens	*6.3*

Bacteria



Organism	MIC [mg/l]
Acetobacter aceti	***50***
Acetobacter pasteurianus	***6***
Asaia bogorensis	*5*
Lactobacillus brevis	***<10***
Lactobacillus plantarum	***<3.9***

Note: Studies have been carried out in apple juice media

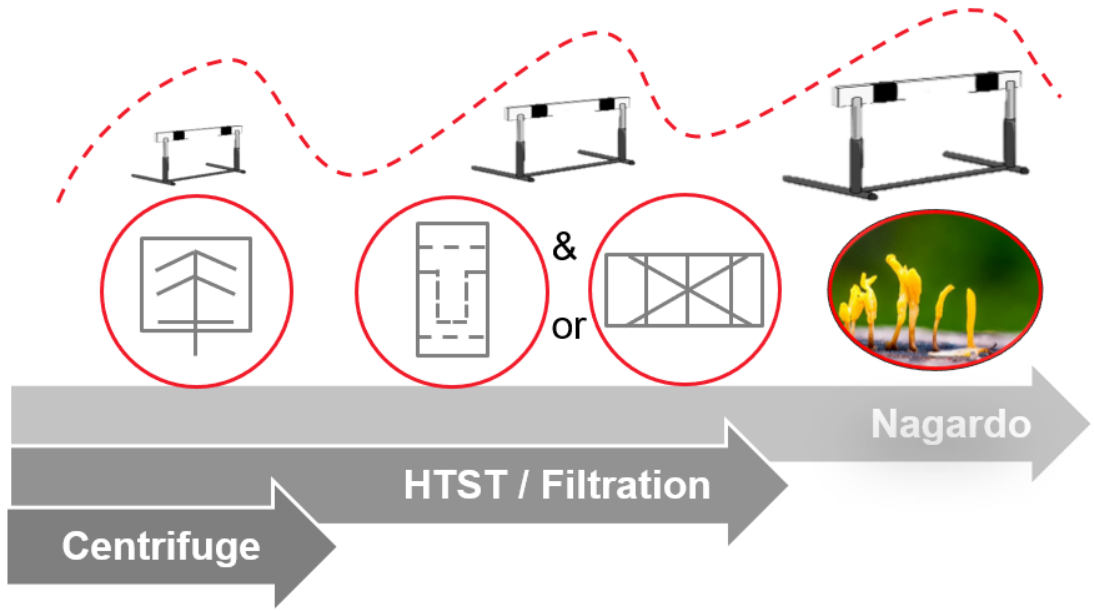
Nagardo® makes non-alcoholic beer on draft finally become reality!

Microbiological protection for your draft beer

- Once connected to tap, non-alcoholic beer in kegs has **high risk** of spoilage:
  - Cleaning status of draft system often unknown
  - Actual shelf life not predictable
- **Persistent antimicrobial protection** is required
- **Nagardo® provides the required protection on draft to enable:**
  - Finally enjoy freshly tapped non-alcoholic beer!
  - Join this new and rapidly growing market
  - Fulfill today's customer demands by bringing non-alcoholic draft beer to festivals and events

What does a robust hurdle concept to control contamination look like?

More and higher hurdles – less microbes



> 90 % reduction of yeast cells	HTST is able to kill 100 % of the yeast cells and > 99,9 % of bacteria	Prevents refermentation after filling
	Filtration reduces initial yeast cell load < 1 cfu/ml	

Benefits

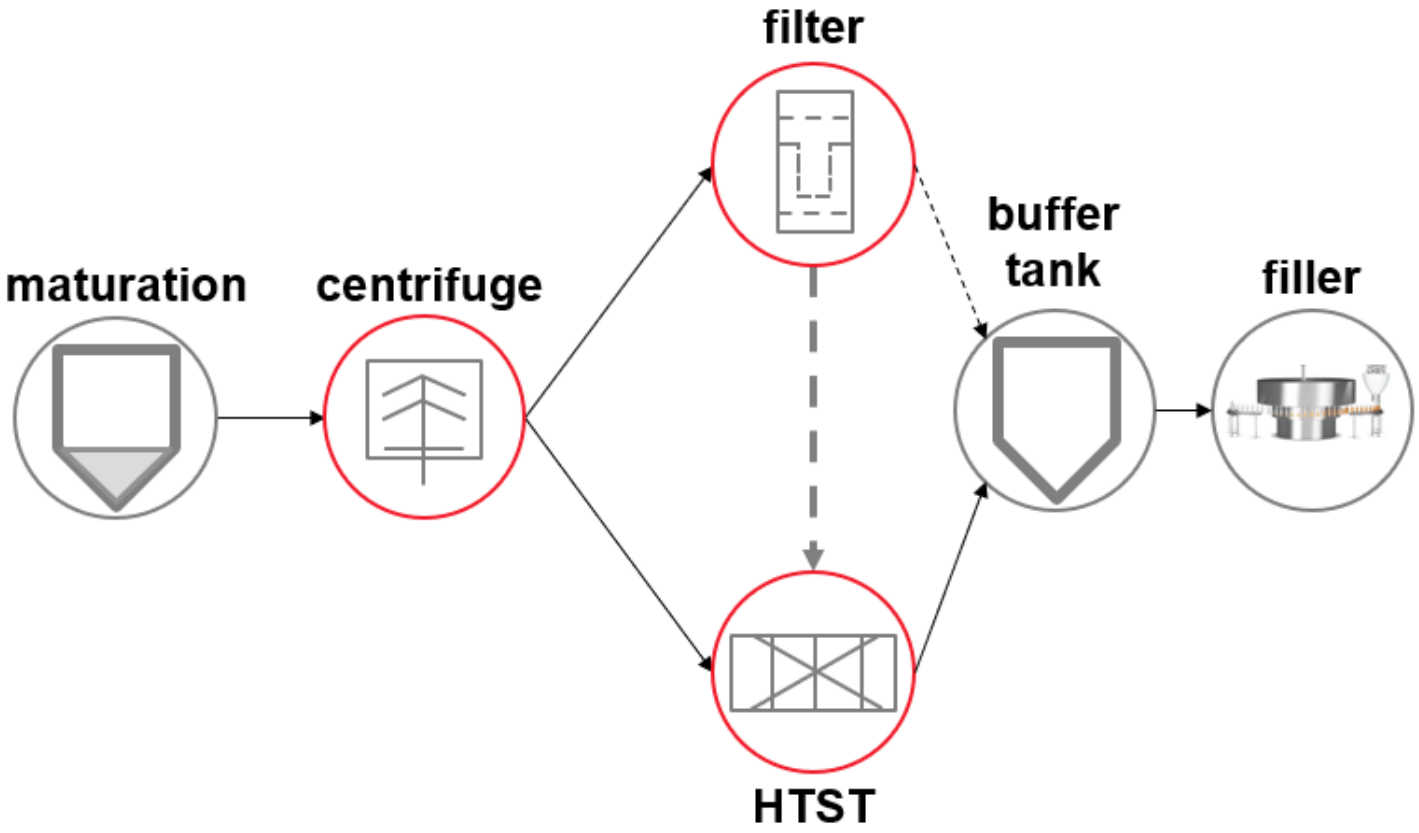
Combined effects of commonly used beer treatment technologies and Nagardo® application lead to:

- **shelf-life extension** with no/low investment effort
- while offering **new market opportunities**
- based on **increased distribution radius**
- and **less quality risk** for draught beer applications due to **unknown hygiene conditions** on tap

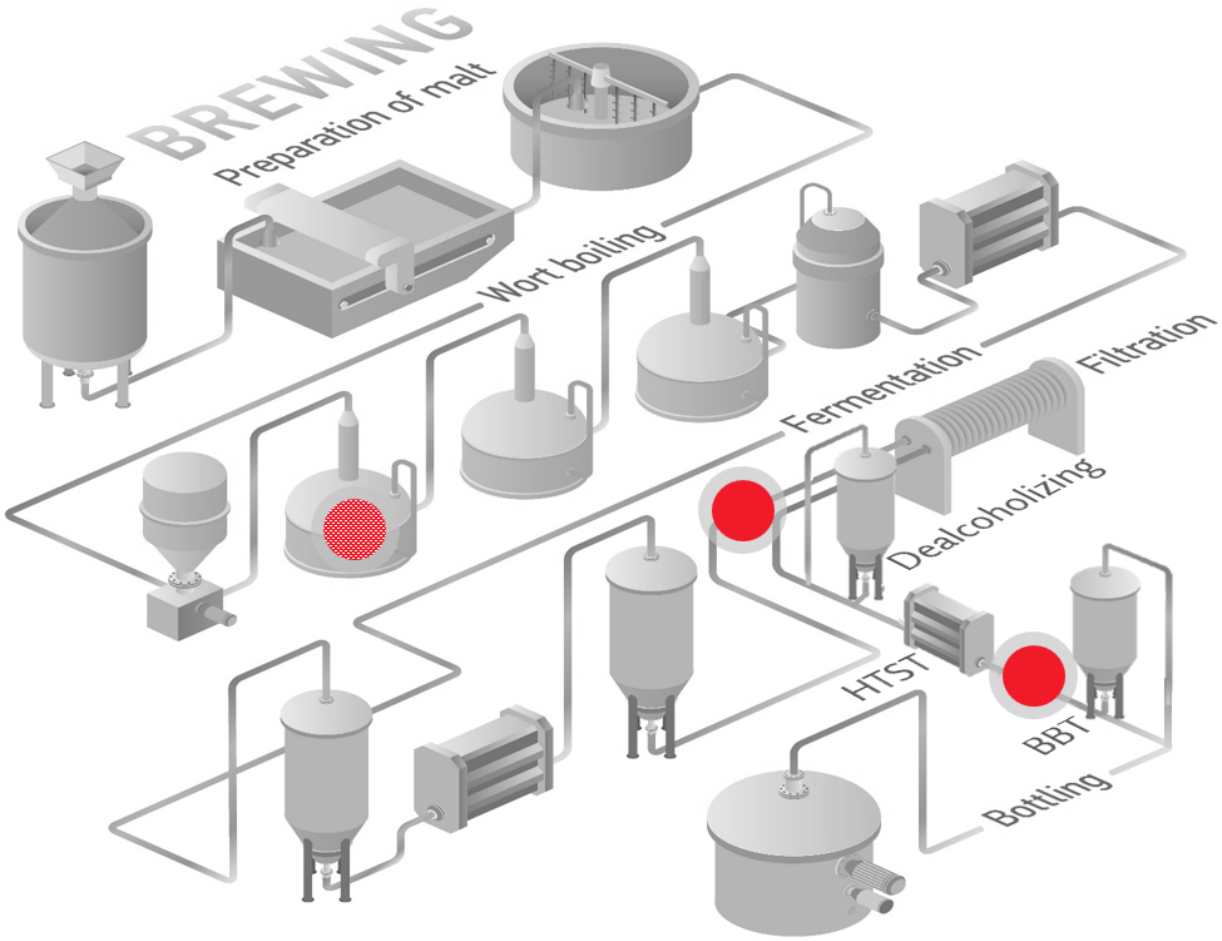
Pre-treatment of NAB is essential allowing Nagardo® to protect against secondary contamination during filling

Which combinations of pre-treatment are recommended for NAB?

- Centrifugation is highly recommended to lower the yeast amount prior to final treatment. Nevertheless, typically cells count is still high (10^4 to 10^5 cfu/ml). **Therefore, an additional microbial reduction step must be applied.**
- From a microbiological perspective, **heat treatment** is the preferred option
- For clear beer **filtration** might be sufficient, however combination with heat treatment is the preferred option.

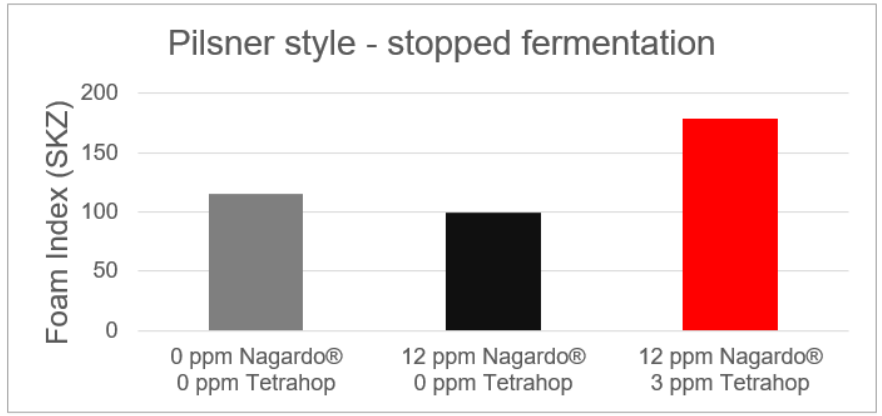


Glycolipids may affect foam stability, but this effect can be easily compensated



Glycolipids have surfactant properties potentially leading to different head retention

- Option 1: Adjustment of the recipe towards malts with increased protein content
- Option 2[1]: Addition of foam stabilizing **hop extracts**, e.g. tetra- | alpha-hop-extract or **PGA**[2] into prefiltered or centrifuged beer



Lab scale experiment: direct addition of Tetrahop and Nagardo® into the bottle followed by Steinfurth foam tester measurement

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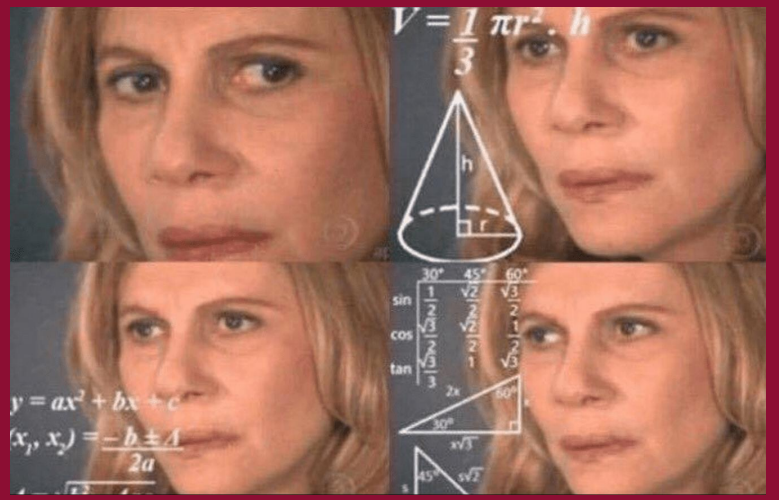
Wow!

So many options for stability



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03 Putting it all Together

Methods of Stabilization

Summary

Method	Food Quality	Food Safety
Tunnel Pasteurizer	✓	✓
Flash Pasteurizer (HTST)	⊗	✓
Persistent Preservatives	✓	⊗
Nagardo	✓	⊗
Flash Pasteurizer + Persistent Preservatives	✓	✓
Flash Pasteurizer + Nagardo	✓	✓

ANY QUESTIONS?

THANK YOU!

KYLE SOMERS

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ADDITIONAL FOOD SAFETY RESOURCES

- Brewer's Association and MBAA
  - MBAA Food Safety Resources
  - BA Food Safety Resources
  - BA Food Safety Modernization Act FAQs
- Educational programs
  - Cornell University Extension - Good Manufacturing Practices
- Food Process Authorities
  - Food Processing Authorities Directory

REFERENCES

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