

Low and Non-Alcohol Beer Production for Nanos

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The Volstead Act of 1919 forced brewers to either find a way to adapt or shutter their doors.

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"No person shall on or after the date when the eighteenth amendment to the Constitution of the United States goes into effect, manufacture, sell, barter, transport, import, export, deliver, furnish or possess any intoxicating liquor except as authorized in this Act, and all the provisions of this Act shall be liberally construed to the end that the use of intoxicating liquor as a beverage may be prevented."



**The first
modern NA
beers quickly
followed ...**

**while the likes
of Al Capone
pursued other
endeavors in
the wake of
Prohibition.**



PROHIBITION ENDS AT LAST!

DECEMBER 5, 1933



Prohibition-Era NA's

Essentially Vanish in 1933

Highlights in Modern NA History

The Binding Brauerei releases Clausthaler and credited with being the first modern NA.

1979



Miller is first major American brewery to release since the repeal of prohibition

1989



Firestone & Fletcher formed as a partnership among partners Firestone, Fletcher, & Lewis.

1986



Heineken 0.0 makes its debut in 2017

Athletic Brewing Company releases its first NA craft beers

2018



2017



Current Language About “NABLABs”



LOW ALCOHOL

No legal definition in the US, but typically <3.5% ABV.

<https://theoriginalsmallbeer.com/>



ALCOHOL FREE

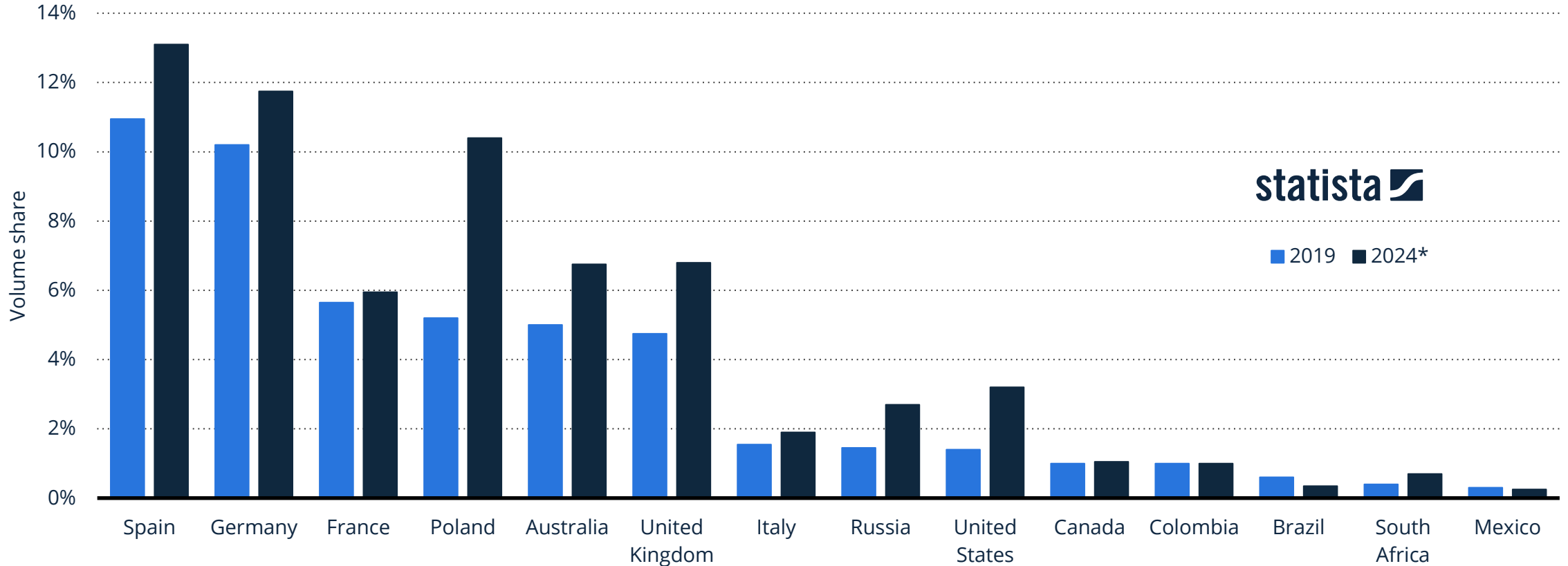
No measurable alcohol permitted. These are the 0.0% ABV products.



NON-ALCOHOLIC BEER

Label must state that beverage “contains less than 0.5% ABV.”

Volume Share of Low-Alcohol and Non-Alcoholic Beer in Select National Markets in 2019 and a Forecast for 2024



Description: Non-alcoholic and low-alcoholic beers had a volume share of more than 10 percent in Spain and Germany in 2019, making them the countries where the beverages were the most popular. Non/low-alcoholic beers are forecast to reach a similar market share in Poland by 2024. In contrast, the market share of these beverages in the U.S. is less than 1.5 percent.

Note(s): Worldwide; 2020

Source(s): IWSR; Statista estimates

What the armchair pundits are saying ...

- *“NA is a small component of total beer market.”*
- *“Percentage growth is an exaggerated metric.”*
- *“NA is just the current fad and will fade away.”*





Unleashing the Power of NABLABS

One of ABI's Global Smart Drinking Goals is to ensure that low- or no-alcohol beer products make up at least 20% of their global beer volume by 2025.

The ambition is for existing drinkers to integrate no-alcohol beers and beer with 3.5% ABV or lower into their current drink choices, reducing their overall total alcohol intake.

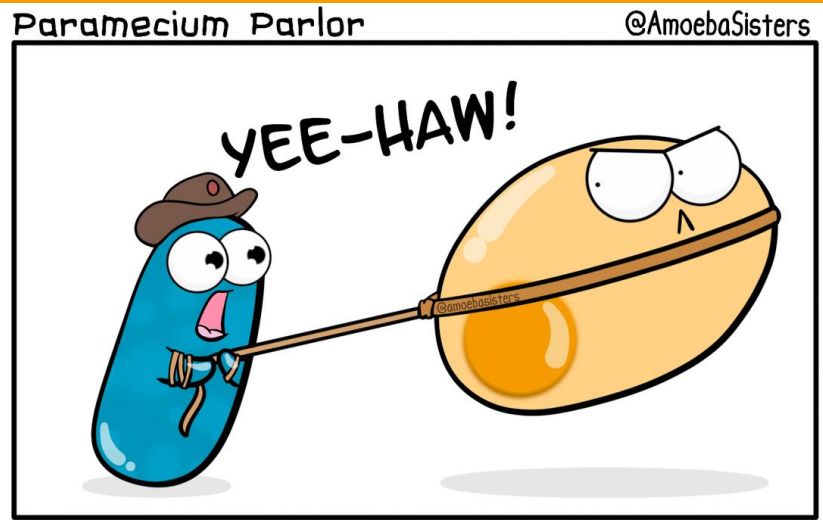
<https://www.ab-inbev.com/smart-drinking/unleashing-the-power-of-nablabs/>

**What's the
secret?**

Primary Production Methods

- Arrested Fermentation
- Cold Contact
- High Temperature Mashing
- Alcohol Removal
- Special Yeasts

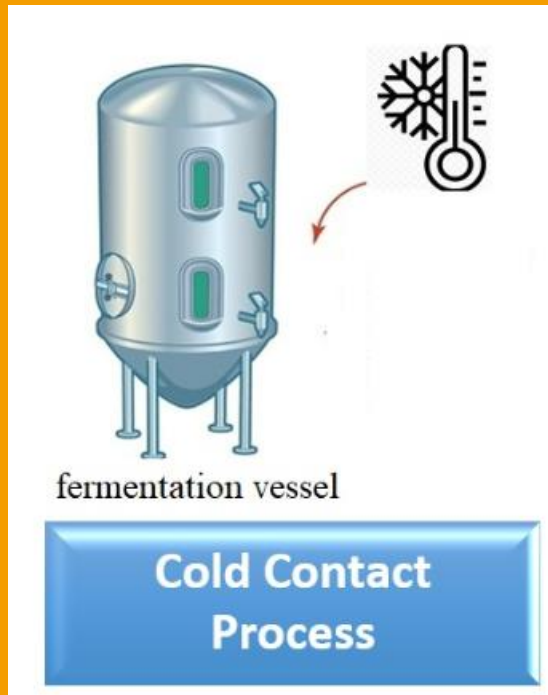
Arrested Fermentation



Process Basics

- Fermentation stopped to limit alcohol production
- Cold fermentation improves process control
- Beer must be stabilized to prevent refermentation

Cold Contact



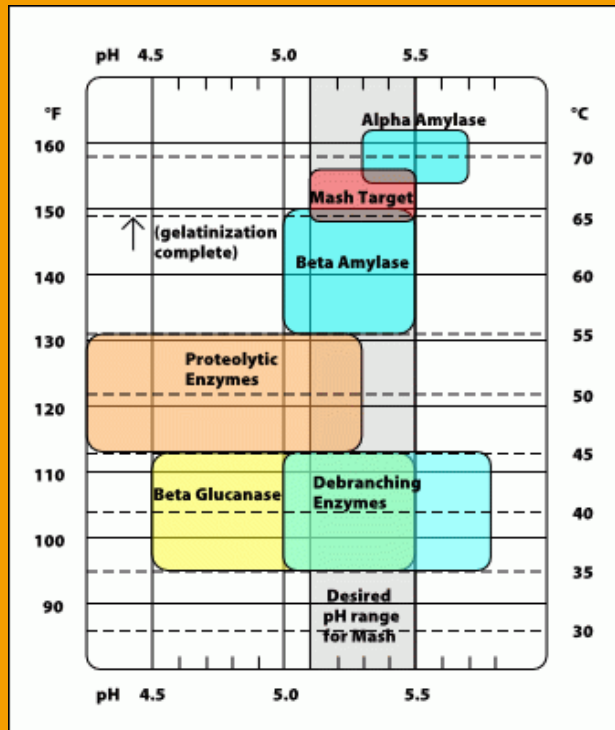
Process Basics

- Wort is pitched with yeast
- Solution kept very cold to minimize/prevent fermentation
- Select yeast reduce wort aldehydes during process
- Recent work¹ has shown promising results from non-traditional yeast, e.g., *Torulaspora delbrueckii*
- Beer must be stabilized to prevent refermentation

¹ <https://onlinelibrary.wiley.com/doi/epdf/10.1002/jib.681>

Picture source: <https://www.mdpi.com/2227-9717/8/11/1382>

High Temperature Mashing

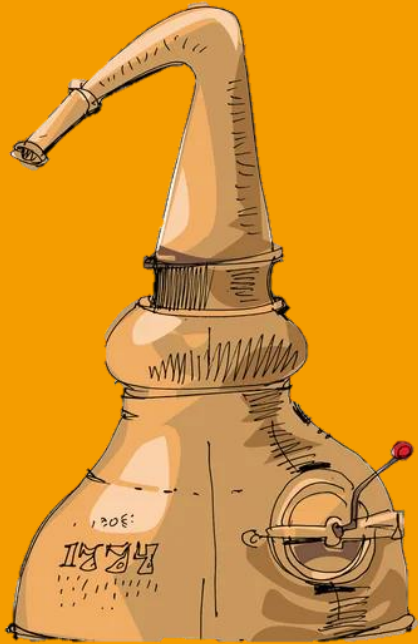


Process Basics

- Minimize maltose production by mashing at high temperatures to restrict beta amylase activity
- Starch conversion is generally defined as the absence of iodine binding and is a function of alpha amylase activity
- High temperature mashing can be used as a sole process method or in conjunction with special yeasts or alcohol removal methods

Picture source: <http://howtobrew.com/book/section-3/how-the-mash-works/mashing-defined>

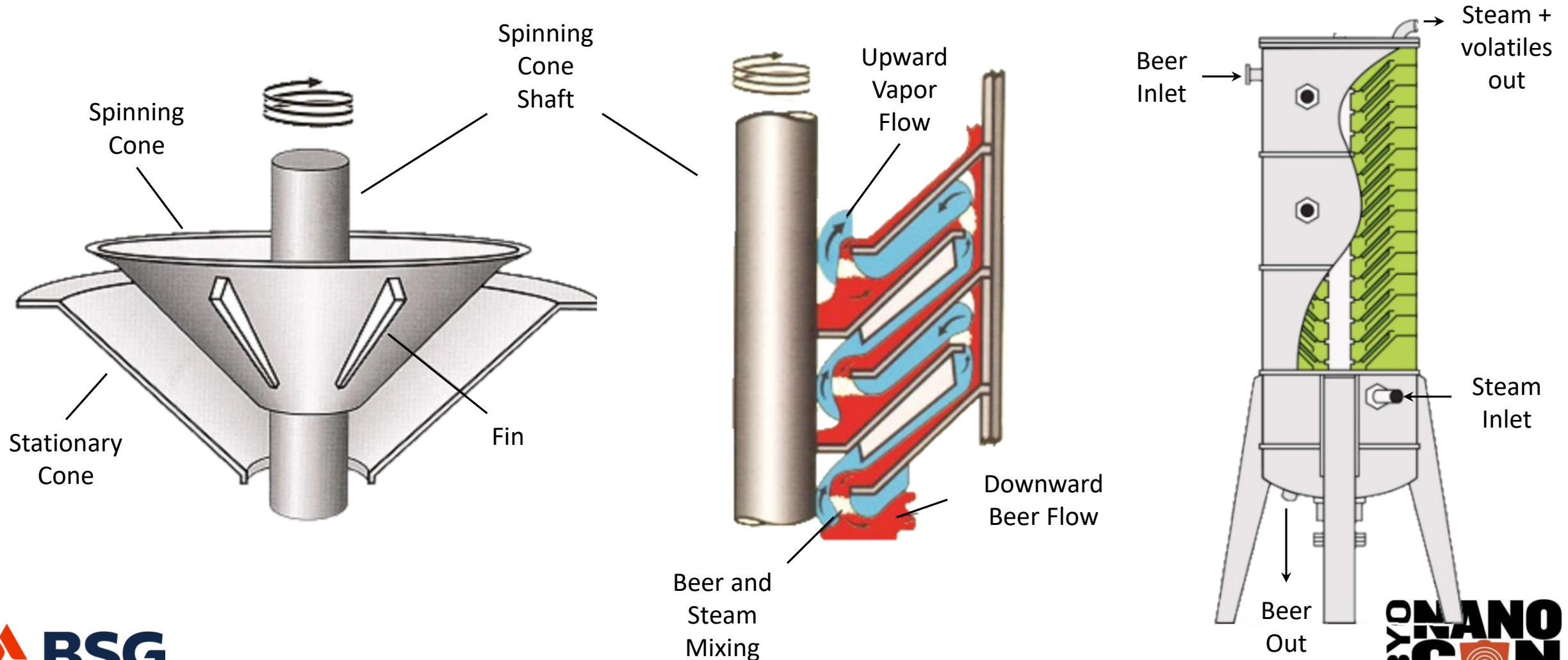
Distillation



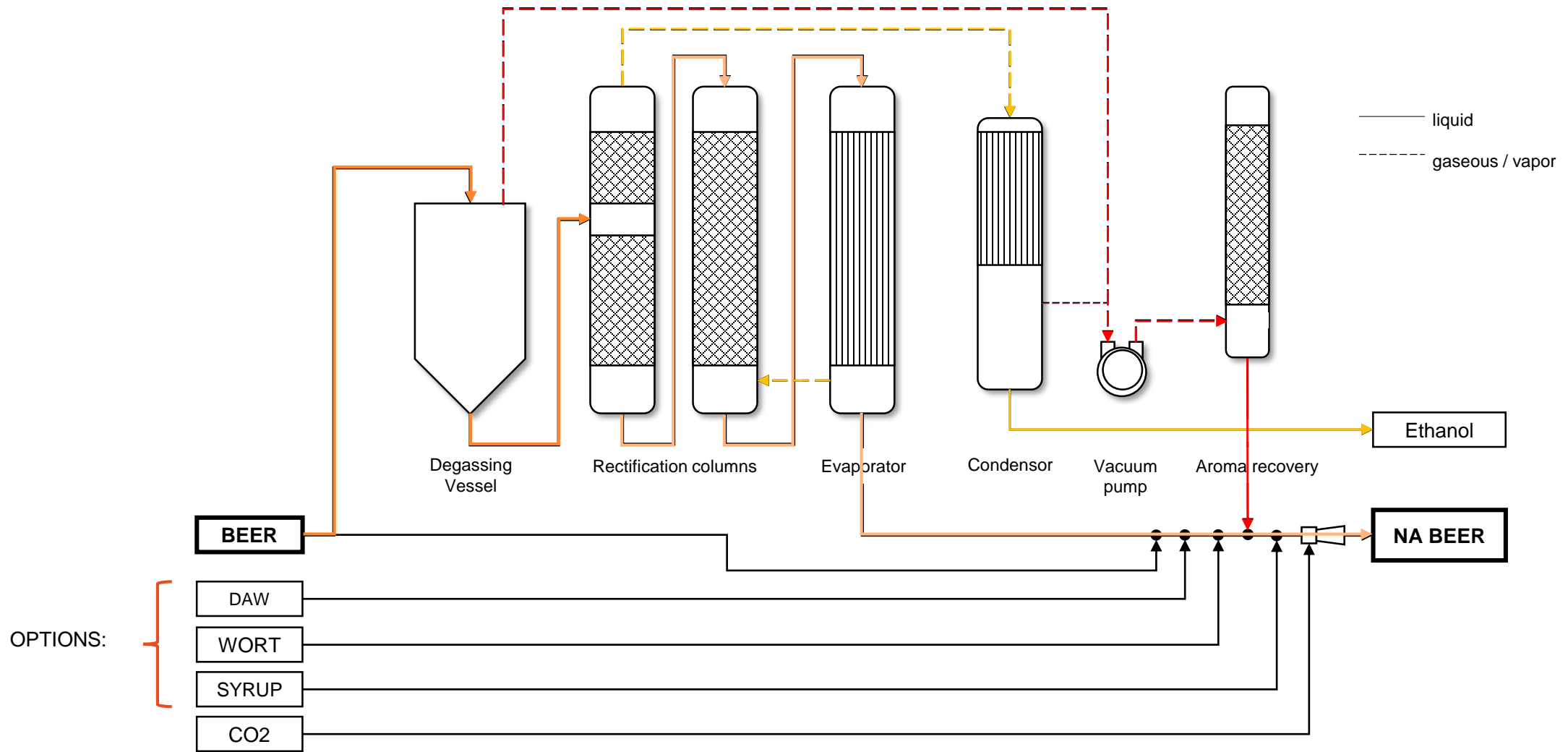
Process Basics

- Beer is normally brewed
- Alcohol removed using a variety of thermal methods, including:
 - Atmospheric distillation (uncommon)
 - Spinning cone (most common in wine)
 - Vacuum distillation (long history in beer)
- Finished beers may or may not contain fermentable extract
- Aroma loss is a key challenge

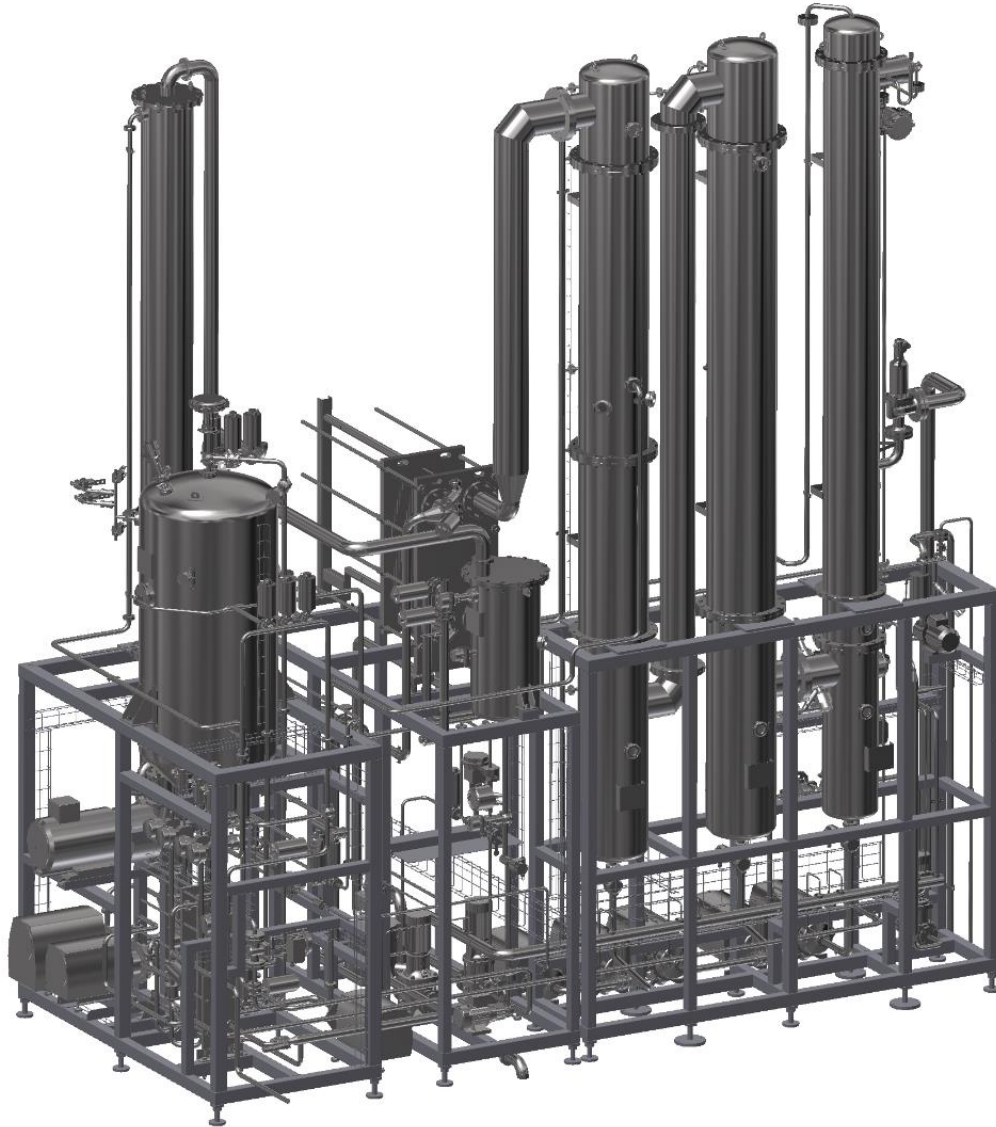
Spinning Cone



Vacuum Distillation



Vacuum Distillation

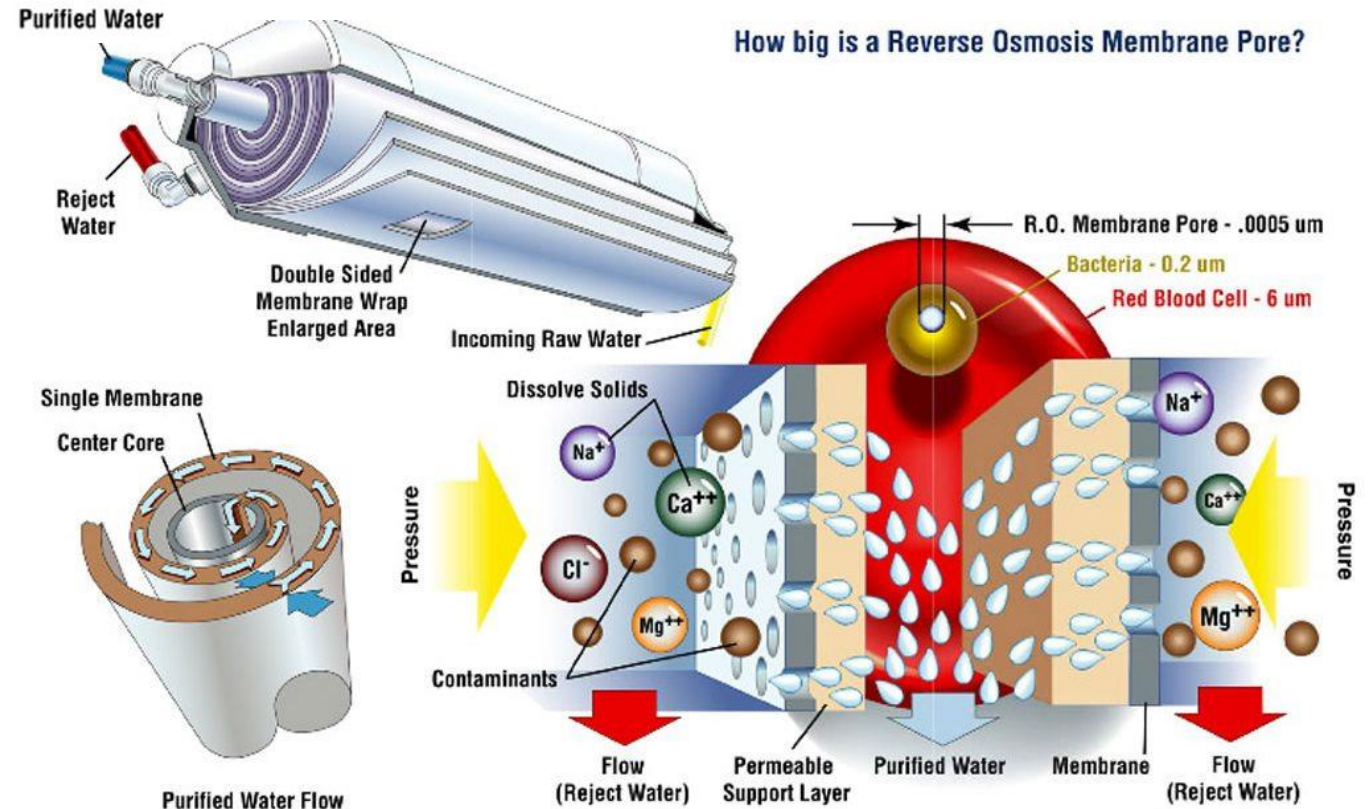


- Low distillation temperatures
- Can produce 0.0% ABV beer
- Ethanol with >70 vol%
- Commonly used

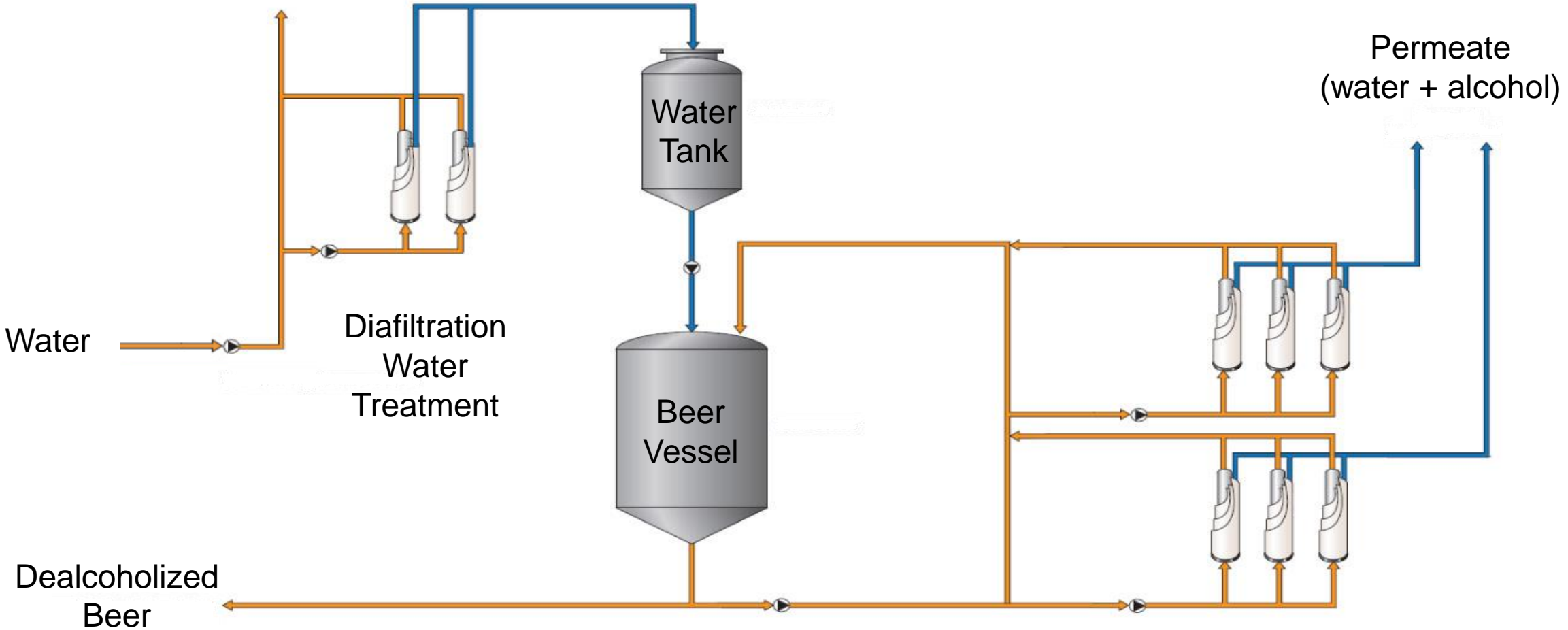
Process Basics

- Beer is brewed typically
- Alcohol, low-molecular compounds, and water are removed in permeate stream
- Deaerated brewing water is added to replace water loss with alcohol
- No significant heat is added to beer

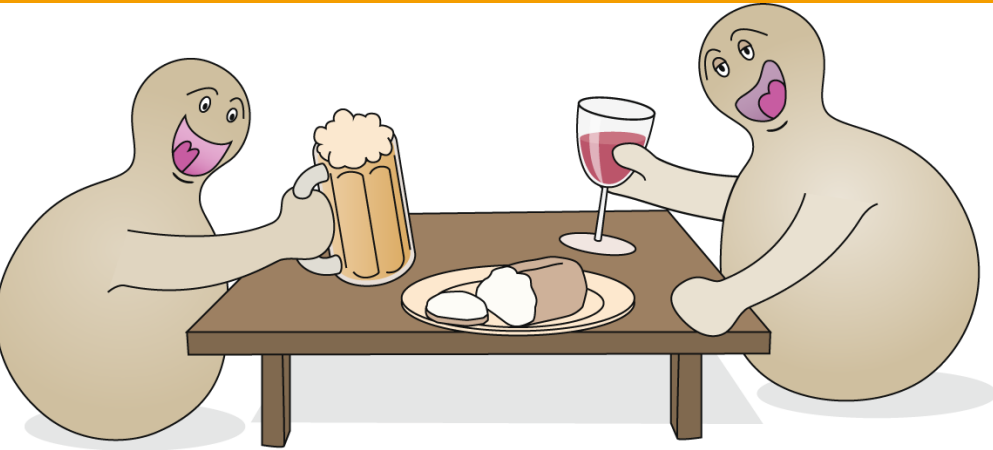
Reverse Osmosis



RO Dealcoholization Process Flow



Special Yeast



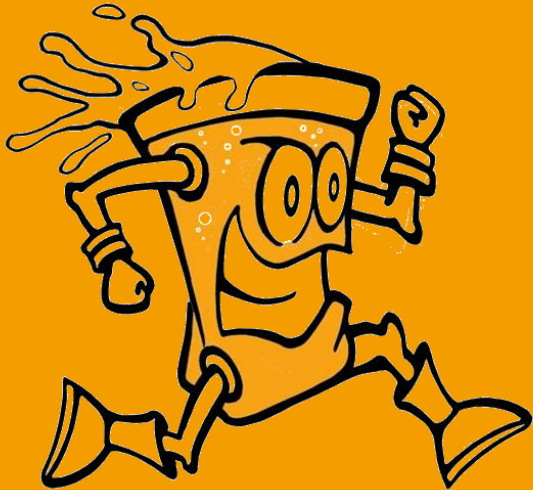
Selected Traits

- > Maltose negative (maltose not fermented)
- > Flavor & aroma
- > Crabtree negative (no ethanol in the presence of oxygen) - *Pichia kluyveri*
- > Aldehyde reduction - *Pichia kluyveri*

Select Commercially Available Yeast Strains

Producer / Distributor	Commercial name	Species
Chr. Hansen	NEER	<i>Pichia kluyveri</i>
Chr. Hansen	NEER Poly	<i>Pichia kluyveri</i>
Chr. Hansen	NEER Punch	<i>Pichia kluyveri</i>
Doemens	400	Not disclosed
Doemens	500	Not disclosed
Doemens	501	Not disclosed
Escarpment labs	NAY (Non-Alcoholic Yeast)	<i>Hanseniaspora uvarum</i>
Fermentis	SafBrew™ LA-01	<i>Saccharomyces cerevisiae</i> var. <i>chevalieri</i>
Technical University of Munich - Weihenstephan	WSL17	<i>Saccharomycodes ludwigii</i>
VLB	NA	<i>Saccharomyces dairensis</i>
VLB	NA	<i>Saccharomyces rosei</i>
VLB	NA	<i>Saccharomycodes ludwigii</i>
White Labs	WLP603	<i>Torulasporea delbrueckii</i>
White Labs	WLP618	<i>Saccharomycodes ludwigii</i>
White Labs	WLP686	<i>Zygosaccharomyces lentus</i>

Consumer Ask?



What Do Consumers Want?

- Beer without alcohol?
- Refreshing and quenching?
- Healthier?
- Flavor?

Consumer Analysis - Population

129 consumers were recruited from around Davis, CA

- All at least 21 years old (*66% under 35)
- US resident for at least 5 years
- 49% female
- 51% male
- 76% held at least a BS degree
- Most regularly consumed beer

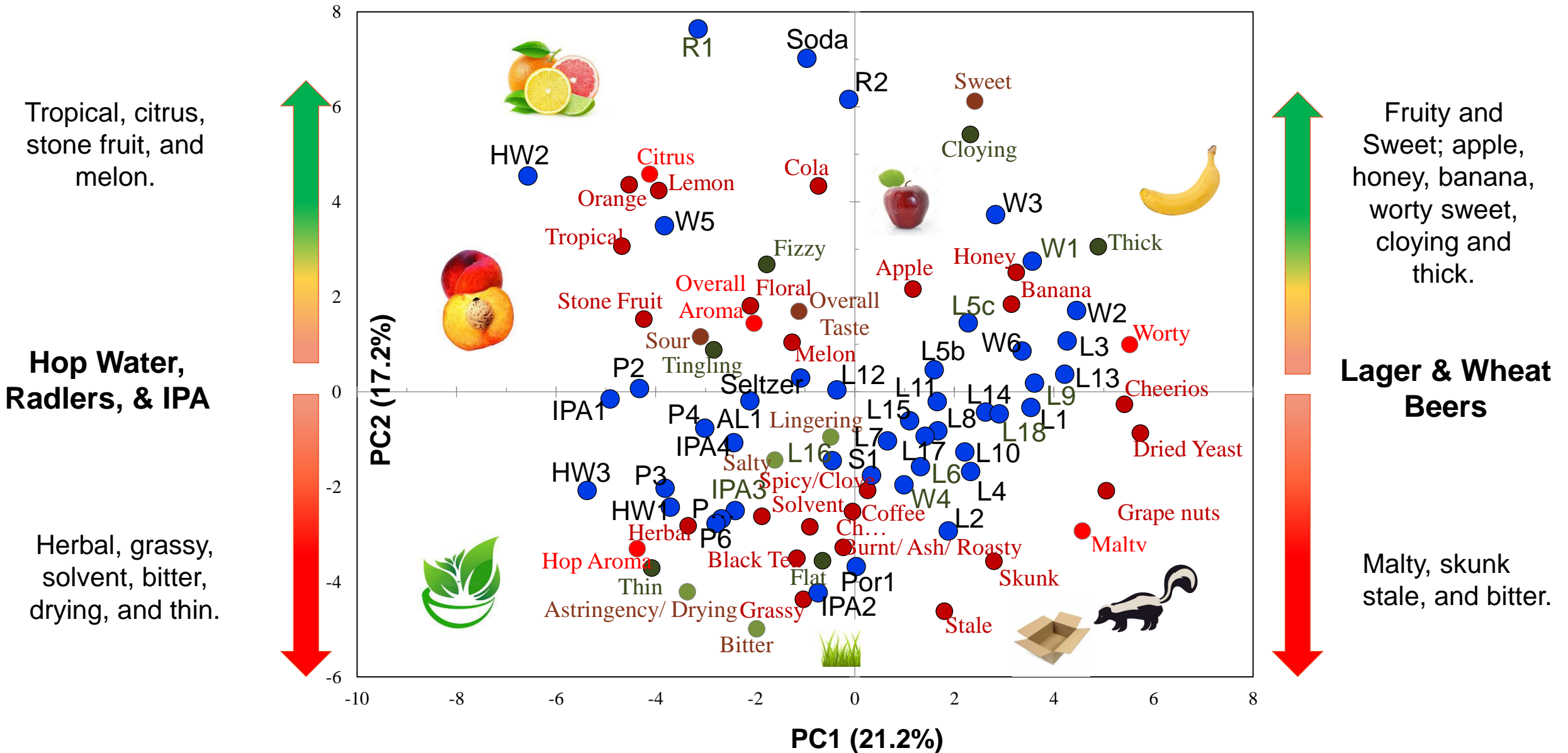
California



Characterizing Volatile and Nonvolatile Factors Influencing Flavor and American Consumer Preference toward Nonalcoholic Beer

Scott Lafontaine, Kay Senn, Johanna Dennenlöhner, Christian Schubert, Laura Knoke, Jörg Maxminer, Annegret Cantu, Nils Rettberg, and Hildegard Heymann
ACS Omega **2020** 5 (36), 23308-23321

Beers Described & Mapped in PCA Space



The Survey

OVERALL, considering the AROMA, TASTE, AND MOUTHFEEL of sample 358, how much do you like this sample?

LIKE EXTREMELY	LIKE VERY MUCH	LIKE MODERATELY	LIKE SLIGHTLY	NEITHER LIKE NOR DISLIKE	DISLIKE SLIGHTLY	DISLIKE MODERATELY	DISLIKE VERY MUCH	DISLIKE EXTREMELY
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Please ONLY consider the SMELL of sample 358 and answer the following question:
How much do you like the AROMA of the sample?

LIKE EXTREMELY	LIKE VERY MUCH	LIKE MODERATELY	LIKE SLIGHTLY	NEITHER LIKE NOR DISLIKE	DISLIKE SLIGHTLY	DISLIKE MODERATELY	DISLIKE VERY MUCH	DISLIKE EXTREMELY
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Please ONLY consider the TASTE and MOUTHFEEL of sample 358 and answer the following question:
How much do you like the TASTE AND MOUTHFEEL of the sample?

LIKE EXTREMELY	LIKE VERY MUCH	LIKE MODERATELY	LIKE SLIGHTLY	NEITHER LIKE NOR DISLIKE	DISLIKE SLIGHTLY	DISLIKE MODERATELY	DISLIKE VERY MUCH	DISLIKE EXTREMELY
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In your opinion, how closely does sample 358 resemble the following beverage classes?

	EXTREMELY SIMILAR	VERY SIMILAR	MODERATELY SIMILAR	SLIGHTLY SIMILAR	NEITHER SIMILAR NOR DISSIMILAR	SLIGHTLY DISSIMILAR	MODERATELY DISSIMILAR	VERY DISSIMILAR	EXTREMELY DISSIMILAR
Beer	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Soda	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sparkling Water/ Flavored Water	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

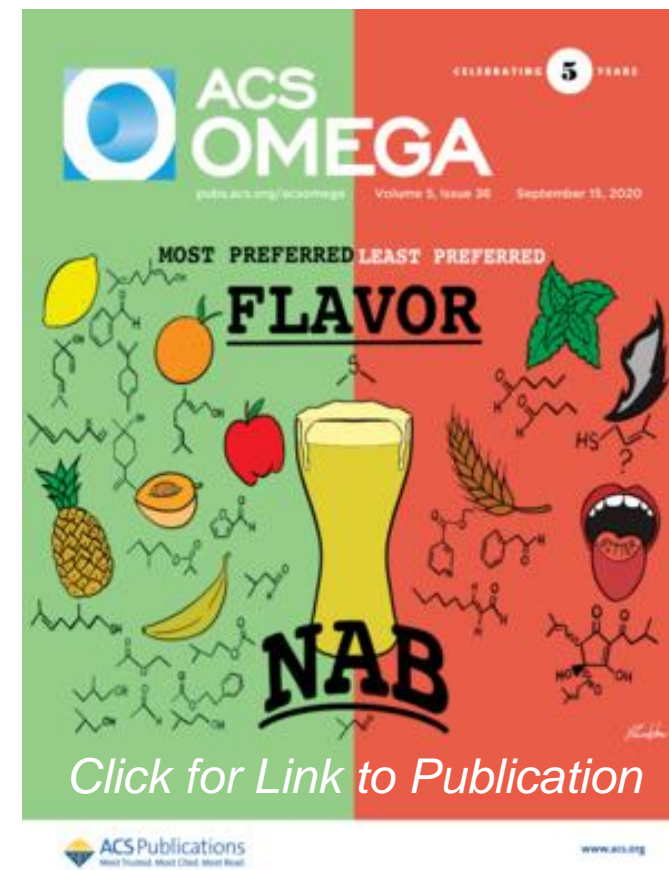
Based on only the aroma, taste, and mouthfeel. Would you purchase this sample?

YES
NO
MAYBE

Read This Paper!!

Characterizing Volatile and Nonvolatile Factors Influencing Flavor and American Consumer Preference toward Nonalcoholic Beer

Scott Lafontaine, Kay Senn, Johanna Dennenlöhr, Christian Schubert, Laura Knoke, Jörg Maxminer, Annegret Cantu, Nils Rettberg, and Hildegard Heymann
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Cautionary Note!

NABLABs lack the inherent protection of full-strength beers

Potential Risks Include:

- Much lower alcohol
- Higher pH
- Lower hopping rates
- Higher residual extract



Pathogens cannot survive in beer owing to the antimicrobial 'hurdles', including the kettle boil, hop bitter acids, low pH, ethanol, carbon dioxide (CO₂) and the lack of nutrients and oxygen (depicted by the wasteland). Artwork by Ms Peggy Hsu. Reproduced with permission from Elsevier.

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In-Package Pasteurization

- The only agreed upon method for packaged NA and Zero Alcohol beers.
- Draft products are a huge concern because of the lack of control of draft lines in the on-premise market.
- Taproom breweries should be extremely cautious when considering these products.
- Several recent references available in the literature.

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Click for Link to Publication



ELSEVIER

Journal of Food Protection

Available online 20 October 2023, 100183

In Press, Journal Pre-proof [?](#) What's this? [↗](#)



Research Paper

Survival of Foodborne Pathogens in Low and Non-Alcoholic Craft Beer

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What Would The Wiz Do?



Ideas for Taproom Breweries

- Ask my customers if they want these products
- Brew low-alcohol beer (2.5 - 3.5% ABV)
- Brew styles showing tropical and fruity notes
- Look for ways to provide mouthfeel without becoming cloyingly sweet
- Talk to my suppliers for assistance
- Offer NA and Zero Alcohol guest beers
- Survey the market
- BE SAFE!!

Questions?

Thank You!

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