



# GUIDE TO MAKING **NON-ALCOHOLIC BEERS THROUGH FERMENTATION**



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# WHY MAKE NON-ALCOHOLIC BEERS?

Non-alcoholic beers are now one of the biggest trends in craft brewing. There are many reasons for this trend. Many beer consumers are cutting back on alcohol consumption, but do not want to settle for grocery store brands of NA beer.

As a result, craft brewers are starting to explore production of non-alcoholic beers at an accelerating rate. If this sounds like you, congratulations! You've found the right place. Before you proceed with adding a bunch of NA beers to your brew schedule, please consider the following questions:

**1. Why are you making a non-alcoholic beer?**

The answer should not be “because everyone else is doing it”.

**2. Who will you be selling your non-alcoholic beer to?**

What channels will you sell through? Taproom? Local distro? Looking to go country-wide? What audience are you appealing to? Are you looking to grow sales from existing customers or add a new customer base?

**3. Are you prepared to dump a few batches of beer?**

These beers are not easy to make. We are here to help guide you, but you can still expect a lot of trial and error when developing your non-alc brew.

**4. Are you sure this is the best use of your brewery's R&D time?**

Consider if the time would be better spent working on other projects that will contribute more to the bottom line of your business.

If these questions didn't scare you off, or if you're just curious about how to make NA beers, read on! Our goal is to provide the best guidance for producing non-alcoholic beers through fermentation.

# INTRODUCTION TO NON-ALCOHOLIC BEER

**By most definitions, non-alcoholic beers (or “NA Beers”, or “Non Alc Beer”) are generally considered to contain less than 0.5% alcohol by volume (ABV). Alcohol-free beers by comparison contain zero alcohol (0.0%).**

There are several different methods a brewer can use to make non-alcoholic beers:

- Dealcoholization through evaporation (e.g. vacuum distillation)
- Dealcoholization through membranes (e.g. reverse osmosis)
- Arrested fermentation with standard yeast
- Limited fermentation with maltose-negative or maltotriose-negative yeast
- Cold contact fermentation

**Broadly speaking, we can divide NA beer production into two categories: dealcoholized beers, and fermented NA beers.**

There are two subcategories of dealcoholization methods. The first is dealcoholization through evaporation, otherwise known as vacuum distillation. In this method, the beer is heated under vacuum and distilled to remove the ethanol. This reduces the alcohol content of the beer, but can also strip some of the volatiles (such as yeast esters). This method has been used for many decades to produce non-alcoholic beers.

The second dealcoholization method uses fine membranes to separate the alcohol molecules from other soluble molecules, similar to how a reverse osmosis device operates. Since pressure is used rather than heat and the separation can be more precise than some older vacuum distillation methods, membrane dealcoholization can be an effective way to produce full-flavour dealcoholized beer. The tradeoff for this method is typically that there are high capital costs associated with units capable of high throughput.

Overall, most dealcoholization technologies are not accessible to smaller craft brewers. However, new solutions such as contract beer producers investing in dealcoholization and pasteurizing equipment, as well as the possibility of mobile or rental dealcoholization and pasteurization outfits (a similar business model to mobile canning).

# INTRODUCTION TO NON-ALCOHOLIC BEER

By contrast, producing non-alcoholic beers through fermentation can be accessible to smaller craft breweries, especially if they have access to shared or contract pasteurization equipment.

This guide pulls from several different resources created by Escarpment Labs and others, including:

- [Approaches to Non-Alcoholic Beer Fermentation](#)
- [How to Homebrew a Low Alcohol IPA](#)

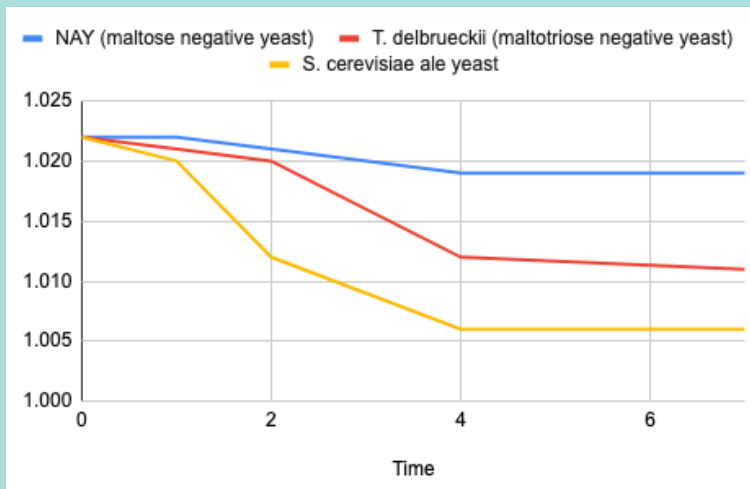


# HOW DO BREWERS MAKE FERMENTED NA BEERS?

There are four major strategies used for producing non-alcoholic beers through fermentation:

- 1. Standard yeast using arrested fermentation (full attenuation is interrupted)**
  - Benefits: You can use any yeast.
  - Drawbacks: Missing the cold-crash and removal of yeast by a couple of hours can mean your beer is over 0.5% ABV. Risk of fermentation intermediates such as acetaldehyde, DMS.
- 2. Maltose-negative yeast (only ferments glucose/fructose/sucrose, attenuation 10-25%)**
  - Benefits: Easy process, “set it and forget it” for a few days.
  - Drawbacks: Limited flavour expression possibilities compared to many *Saccharomyces* yeasts. Low or no flocculation is typical.
- 3. Maltotriose-negative yeast (does not ferment maltotriose, attenuation 50-60%)**
  - Benefits: Can use maltotriose-negative *S. cerevisiae* yeasts and their benefits (flocculation and flavour).
  - Drawbacks: Also at risk of over-fermenting or over-attenuating the wort.
- 4. Cold Contact Fermentation (wort and yeast are mixed while cold)**
  - Benefits: simple process.
  - Drawbacks: Very little fermentation actually occurs - just enough contact between yeast and wort to call the resulting product “beer”.

# HOW DO BREWERS MAKE FERMENTED NA BEERS?



## Attenuation Comparison of MNY, MTNY, Regular Yeast

The differences in fermentation profiles for a maltose-negative yeast (*H. uvarum*), and two maltotriose-negative strains (*T. delbrueckii* and *S. cerevisiae* from Ghana beer).

At Escarpment Labs we have focused on maltose-negative yeasts as this is the easiest way to reliably yield a beer of less than 0.5% ABV. However, all these methods can produce good beer with enough practice.

In general, for most fermented NA beers, we recommend the following:

- Use ALDC enzyme to reduce the risk of diacetyl formation
- Make a low-gravity wort with a high mash temperature to reduce fermentability
- Use yeast nutrients in the whirlpool to make up for the low-nutrient wort
- Pasteurize the finished beer (and read our other notes on the safety of NA beer)

Looking to get started with brewing alcohol-free beer? Check out the sections on NAY (Non-Alcoholic Yeast) and Recipes.

# FOOD SAFETY RISKS OF NON-ALCOHOLIC BEER

To ensure food safety of non-alcoholic beers, you need to do at least one of the following:

- Flash Pasteurize
- Tunnel Pasteurize
- Sterile Filtration
- Acidify to below pH 3.5

Even so, there are risks associated with the production of non-alcoholic beers.

When it comes to producing a safe food product, there are several factors you can control to keep fermented foods safe for consumption. They are:

- **pH/acidity**
  - Products with a pH below 4.2 have a lower risk of harbouring foodborne pathogens.
- **Alcohol**
  - makes the product stable as many pathogenic organisms cannot survive in the presence of alcohol.
- **Preservatives**
  - use various chemical means to restrict the growth of microbes. This includes options such as potassium sorbate (most active below pH 4.5) and sodium benzoate (most active between pH 2.5 and 4). Additional options include solutions based on chitosan (a yeast inhibitor) or dimethyl dicarbonate (DMDC; a yeast inhibitor).
- **Salinity**
  - Many pathogens cannot survive in brine solutions which allows preserving bacteria (such as Lactobacillus) to thrive and create acid. While great for pickles, this isn't as relevant for non alcoholic beer.

For products that are missing these elements, you need to introduce something into your process to reduce or eliminate the risk of pathogens. Often this comes in the form of pasteurization or other means of stabilization.



# PASTEURIZATION REQUIREMENTS FOR NON- ALCOHOLIC BEER

## What is Pasteurization?

Pasteurization involves heating a product in order to achieve greater microbial stability. For beer, there are two main types of pasteurization: flash pasteurization and tunnel pasteurization.

Flash pasteurization involves passing the beer through a heat exchanger inline, to heat and then rapidly cool the product to achieve reduction in the concentration of viable microbes. With flash pasteurization, note that the cooled product will typically be passed through common hoses, filling equipment, and cans/bottles, all of which mean that flash pasteurized non-alcoholic beers are still at risk of being contaminated with regular *S. cerevisiae* house yeast.

Tunnel pasteurization involves passing packaged product through a tunnel that has a heated section and a cooled section, to achieve heating and cooling of the packaged product. In general, tunnel pasteurization is safer for sensitive products such as non-alcoholic beer.

## How much do I need to pasteurize an NA beer?

Pasteurization Units required depend on several other variables in your beer, including the alcohol content (ABV) and bittering units (IBU) of your beer.

Beer	IBU	PU
Non alcoholic beer (<0.5% ABV)	8	83
Non alcoholic beer (<0.5% ABV)	25	57
Non alcoholic beer (<0.5% ABV)	50	41
Standard beer (4.5% ABV)	6	14
Standard beer (4.5% ABV)	25	12
Standard beer (4.5% ABV)	50	10

**The less alcohol and the less IBU, the more Pasteurization Units are required.**

This table is based on analysis of the available scientific literature.

# CAN I HOMEBREW A NON-ALCOHOLIC BEER?

Yes, with some caveats including the safety considerations previously explained. Our main reason for avoiding the homebrew distribution of non-alcoholic yeast products is safety.

In order to make safe low and no alcohol products at home, we suggest the following two categories:

- Non-Alcoholic Sours using heterofermentative lactic acid bacteria (*L. brevis*)
  - Acidity (pH less than 3.5) ensures the product is safe as long as it is kept cold
  
- Low Alcohol IPAs using regular yeast (ABV >1%)
  - Slightly higher ABV will reduce risk of contamination
  - High IBU or hop content will reduce risk of contamination
  - Ensure you acidify the final beer to below 4.2 pH
  - Ensure product is kept cold

Two of the recipes in this guide are compatible with homebrewing.



# NAY

## (NON-ALCOHOLIC YEAST)

### Do you want to start making non-alcoholic beers?

Introducing NAY (Non-Alcoholic Yeast), the yeast for making delicious non-alcoholic beer! Whether you want a clean, refreshing lager or a fruitier, hoppier IPA, NAY will help you achieve the perfect results. With excellent flavour and performance in beers below 0.5% ABV, NAY is your new go-to yeast for alcohol-free brewing.

Scientifically, it is a strain of *Hanseniaspora uvarum* yeast we isolated from spontaneously fermenting crabapples here in Guelph. NAY is a maltose-negative yeast, meaning it does not ferment most of the sugars in wort. It is non-phenolic and non-diastatic.

### Key Characteristics of NAY

**ATTENUATION:** 10-20%

**TEMPERATURE:** 20-25°C (68-77°F)

**DIASTATIC:** No

**FERMENTATION RATE:** Medium (4-6 days)

**SUITABLE BEER TYPES:** Non-Alcoholic Beer

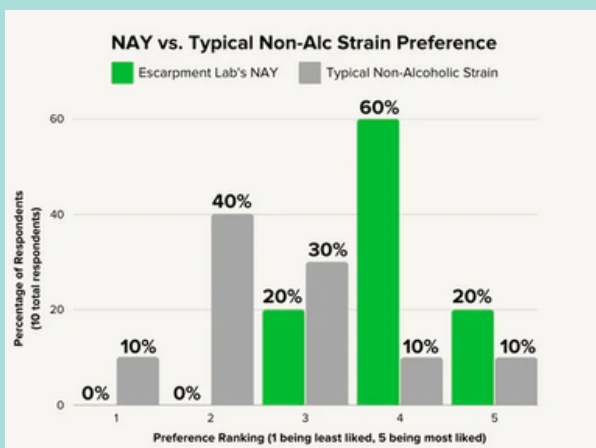
**FLOCCULATION:** Low

**ALCOHOL TOLERANCE:** Low

**PHENOLIC:** No

**BIOTRANSFORMATION:** Low

**FLAVOUR PROFILE:** From Clean to Fruity



### NAY vs. Typical Non-Alc Strain Preference

NAY was preferred by trained tasters in a blind comparison to the industry standard *Saccharomyces ludwigii* WSL-17 strain.

# NAY

## (NON-ALCOHOLIC YEAST)

### NAY Testimonials

NAY was tested by a craft brewer in Ontario who is exploring the non-alcoholic trend. Here's what they had to say:

*"Overall, I'd say the yeast did exactly what I wanted it to! Our goal was to start at a much lower Plato wort than would be typical so that the beer would finish drier and still ferment to 0.3-0.5% abv (finished at 0.32% abv), and that it did."*

Our friends at Firehall Brewing in B.C. also tested out NAY! Sid Ruhland at Firehall says:

*"The Fire Drill N.A.I.P.A. is refreshing and hoppy, with strong aromas of citrus fruit and evergreen from the hop varieties chosen. The wortiness is mild, and if anything lends a pleasant sweetness to balance the bitterness. I'm sure lager drinkers won't be fans of it, so it's a NAB suited for true craft beer enthusiasts."*

### Instructions for making non-alcoholic beer using NAY

NAY was tested by a craft brewer in Ontario who is exploring the non-alcoholic trend. Here's what they had to say:

#### Recipe Formulation and Ensuring <0.5% ABV

- Target Original Gravity between 1.016-1.022 (4-5.5°P).
- Use malts that will add body to the beer.
- Use a hot and short mash of 72-74°C for 15-30 minutes. This helps produce some fermentable sugars for the yeast but ensures fermentation to below 0.5% ABV.
- Since your wort will be low strength, its nutrient content will also be low. We recommend dosing Yeast Lightning Nutrient at 1.5x the standard rate (equalling 6g/hL) for optimal performance.
- Oxygenate the wort like normal (target 8-10ppm if you have a wort level dissolved oxygen meter).
- Acidify your wort to a starting pH of below 4.5 for the purpose of food safety.

# NAY

## (NON-ALCOHOLIC YEAST)

### Instructions for making non-alcoholic beer using NAY (cont'd)

#### Fermentation

- Pitch NAY as you would any other liquid yeast.
- We recommend adding ALDC (alpha acetolactate decarboxylase) at the manufacturer's recommended rate at the start of fermentation to reduce the risk of diacetyl formation.
- Take extreme care to ensure sanitation of all cold side processing equipment including heat exchangers, hoses, and fermentors. Contamination by regular *Saccharomyces* yeast in the brewery environment will result in your beer being over 0.5% ABV.
- Since this yeast only ferments glucose/fructose/sucrose, do not expect a vigorous ferment or blowoff. Use specific gravity readings with a hydrometer or portable density meter as your guide.
- Specific gravity will drop between 0.5-1°P after 4-6 days of fermentation at 20-25°C.
- Cold crash once you have not observed any gravity drop for 2 days.
- This yeast is non-flocculent but will settle with time. Beer clarification will be greatly accelerated with fining, filtration, or centrifugation.
- You can use any fining agent that will drop out yeast to clarify beer made using NAY.

#### Dry Hopping and Fruiting Fermented NA Beer

- Hop Creep is a significant risk for over-attenuating NA beer. This is because enzymes from dry hops can release dextrose from the longer chain sugars in the beer, resulting in additional fermentation.
- We recommend liquid aroma hop products or other products that have been shown to not cause hop creep.
- Any fruit additions must happen after chilling the beer to below 2°C to avoid over-attenuation. Any fruit additions before or during fermentation will alter the ABV of the final product as maltose-negative yeasts can still ferment the glucose and fructose found in the fruit. Any fruited NA beers must be pasteurized to ensure safety and stability.

# NAY

## (NON-ALCOHOLIC YEAST)

### **Instructions for making non-alcoholic beer using NAY (cont'd)**

#### **Processing Fermented NA Beer**

- Acidify the beer to below pH 4.2 for food safety.
- Force carbonate the beer. Do not consider bottle conditioning or spunding.
- Take extreme care when transferring non-alcoholic beers as they are exceptionally prone to any contamination including by regular *Saccharomyces* yeasts in your brewery environment.
- We strongly encourage thermal processing such as flash pasteurization or tunnel pasteurization for non alcoholic beers. Beer fermented with maltose-negative yeast will contain maltose, making the beer extremely sensitive to cross-contamination by standard brewing yeasts anywhere in the brewery including the packaging line.
- We have found that thermal processing helps to reduce “worty” flavours in NA beers, and that pasteurized NA beers often taste better.
- Some brewers have reported success from sterile filtration.
- Preservatives such as potassium sorbate or sodium benzoate are not as effective at beer pH but are an option for stabilizing sour NA beers.

#### **Storing and Serving Fermented NA Beer**

- Take extreme care if serving NA beer on draft, as a study has shown there is a potential for pathogens to grow in draft lines used to serve NA beer.
- Packaged and thermally processed NA beer should still be kept cold to elongate shelf life.
- Avoid international, inter-provincial, or inter-state shipping of more than 7 days or in uncontrolled temperature conditions.

# NAY

## (NON-ALCOHOLIC YEAST)

### **Additional FAQ**

#### **Can NAY be repitched?**

We don't recommend repitching maltose-negative yeasts unless you are extremely confident in the microbiological control of your facility (all equipment and hoses steam-sterilized and agar plating on every batch). This is because any *Saccharomyces* yeast getting into the batch will result in a higher than desired %ABV.

Note that since you are producing non-alcoholic beer, there will not be excise taxes applied to the malt, which could add to the available yeast budget for your NA program.

#### **Can NAY be propagated in-house?**

We don't recommend in-house propagation of maltose-negative yeasts unless you are extremely confident in the microbiological quality control of your facility. This is because any *Saccharomyces* yeast getting into the batch will result in a higher than desired %ABV.

Note that Escarpments Labs uses a growth medium specially formulated for propagating NAY and your results in wort may vary.

#### **You said it's wild yeast - is it going to infect my brewery?!**

No. Since NAY is maltose-negative, non-phenolic, and non-diastatic, it poses an extremely low risk of contaminating anything in your brewery.

#### **What do I do if my NA beer is slightly over alcohol?**

If the beer is between 0.5-1% ABV, you may be able to dilute the beer with deaerated water to adjust ABV. If the beer is over 1% ABV we suggest blending down with very low ABV beer to achieve a final ABV at or below 0.5% alcohol.

# LOW AND NON-ALCOHOLIC BEER RECIPES

## Recipes suitable for professional brewing:

- Non-Alc Pale Ale
- Low or No Alcohol IPA
- Non-Alc Lager
- Non-Alc Sour

## Recipes suitable for homebrewing:

- Low or No Alcohol IPA
- Non-Alc Sour

## Non-Alc Recipe Legend



Recommended  
for Professional  
Brewers Only



Recipe for NAY



Recommended for  
Homebrewers



Recipe for Hydra



# LOW AND NON-ALCOHOLIC BEER RECIPES

## Non-Alc Pale Ale



Adjust malt quantities to match your own brewhouse efficiency. You may get slightly lower than normal efficiency from the hot mash.

<b>Pre-Boil Gravity:</b>	1.020
<b>Original Gravity:</b>	1.022
<b>Final Gravity:</b>	1.018-1.020
<b>IBU (Tinseth):</b>	~20
<b>Color:</b>	4.4 SRM

### Mash

Hot Mash — 73 °C — 30 min

### Malts

40% — Weyermann Carahell — Grain — 13 SRM

40% — Simpsons Pale Ale Finest Maris Otter — Grain — 2.5 SRM

20% — Weyermann Carapils/Carafoam — Grain — 2 SRM

### Hops

12 IBU — Magnum 12% — Boil — 60 min

200g/hL — Cascade 5.5% — Aroma — 15 min hopstand or whirlpool

### Yeast & Fermentation

Escarpment Labs NAY

Ferment at 25°C for 6 days or until gravity has dropped 0.5-1°P and is stable

Dry hop with Cascade aroma extract

### Additional Notes

Add ALDC enzyme with the yeast, at the manufacturer's recommended rate Add Yeast Lightning at 6g/hL to the whirlpool Follow all other instructions for fermenting and processing NA beers

# LOW AND NON-ALCOHOLIC BEER RECIPES

## Low or No-Alcohol IPA



This recipe is based on our advice for making wort for fermentation by NAY. If you are a home brewer and do not absolutely require your low-alcohol beer to be under 0.5% ABV like professional brewers do, we recommend using a low-attenuation *S. cerevisiae* yeast such as Hydra rather than NAY, which is not available to homebrewers.

We brewed the same recipe using both NAY and Hydra. NAY yielded an ABV of approximately 0.3% while Hydra yielded an ABV of approximately 1.2%.

<b>Pre-Boil Gravity:</b>	1.021
<b>Final Gravity:</b>	1.012 with Hydra, 1.018 with NAY
<b>ABV:</b>	1.2% or 0.3%
<b>IBU (Tinseth):</b>	32
<b>Color:</b>	4 SRM

### Water profile and additions

Ca 65 Mg 19 Na 32 Cl 75 SO 65

Target first wort pH of 5.3, then acidify the whirlpool to 5.0 if using Hydra and to 4.5 if using NAY.

### Mash profile

Hot and Fast

73 °C - 30 min

78 °C - 15 min - Mash Out

### Malts

40% Maris Otter Ale Malt

40% Munich Malt

20% Carapils

# LOW AND NON-ALCOHOLIC BEER RECIPES

## Low or No-Alcohol IPA (Cont'd)



### Hops/boil

Bittering

60 min - 25 IBU - Galena - 14%

### Whirlpool

200g/hL (0.5lb/bbl or 40g per 20L homebrew batch) - El Dorado or other fruity New World

6 g/hL (1.5g per 20L homebrew batch) - Yeast Lightning Nutrient

### Dry Hops

Hop aroma extract (Spectrum, etc) at the manufacturer's suggested rate (equivalent to 200-300 g/hL)

### Fermentation profile

Escarpment Labs NAY (for <0.5% ABV) or Hydra (for <1.5% ABV)

Ferment at 22°C for 6 days or until gravity has dropped 0.5-1°P and is stable

Dry hop with aroma extract if possible, or consider "dip hopping" to reduce impact of hop enzymes

Cool out to 22°C and pitch yeast and monitor for stable FG, dry hopping once stable FG has been achieved.

# LOW AND NON-ALCOHOLIC BEER RECIPES

## Non-Alc Lager



Adjust malt quantities to match your own brewhouse efficiency. You may get slightly lower than normal efficiency from the hot mash.

<b>Pre-Boil Gravity:</b>	1.020
<b>Original Gravity:</b>	1.022
<b>Final Gravity:</b>	1.018-1.020
<b>IBU (Tinseth):</b>	10
<b>Color:</b>	3.2 SRM

### Mash

Hot Mash — 73 °C — 30 min

### Malts

40% — Weyermann Carahell — Grain — 13 SRM

40% — Weyermann Pilsner Malt — Grain — 2.5 SRM

20% — Weyermann Carapils/Carafoam — Grain — 2 SRM

### Hops

7 IBU — Magnum 12% — Boil — 60 min

3 IBU — Hallertau Tradition 5.5% — Aroma — 15 min hopstand or whirlpool

### Yeast & Fermentation

Escarpment Labs NAY

Ferment at 20°C for 6 days or until gravity has dropped 0.5-1°P and is stable

### Additional Notes

Add ALDC enzyme with the yeast, at the manufacturer's recommended rate Add Yeast Lightning at 6g/hL to the whirlpool Follow all other instructions for fermenting and processing NA beers

# LOW AND NON-ALCOHOLIC BEER RECIPES

## Non-Alc Dry Hopped Sour



Some Lactobacillus bacteria are capable of producing small amounts of alcohol. These are known as heterofermentative lactic acid bacteria. This includes Levilactobacillus brevis (formerly Lactobacillus brevis), which is capable of producing up to 0.5% ABV during wort souring.

Therefore, to make a non-alcoholic sour beer, you don't need to use yeast! You can make a low-gravity, unhopped wort and inoculate it with L. brevis. You can then reboil to kill off the Lactobacillus, and then cool down and dry hop while cool or cold, then proceed with carbonating.

Additionally, this beer could be considered “yeast-free” and may be suitable for individuals with yeast sensitivity or allergy, but further validation is required.

Adjust malt quantities to match your own brewhouse efficiency. You may get slightly lower than normal efficiency from the hot mash.

<b>Pre-Boil Gravity:</b>	1.020
<b>Original Gravity:</b>	1.022
<b>Final Gravity:</b>	1.018-1.020
<b>IBU (Tinseth):</b>	Dry hop only
<b>Color:</b>	3.2 SRM

### Mash

Hot Mash — 73 °C — 30 min

### Malts

40% — Weyermann Carahell — Grain — 13 SRM

40% — Weyermann Pilsner Malt — Grain — 2.5 SRM

20% — Weyermann Carapils/Carafoam — Grain — 2 SRM

# LOW AND NON-ALCOHOLIC BEER RECIPES

## Non-Alc Dry Hopped Sour (Cont'd)



### Hops

Dry Hop 400g/hL (~1 lb/bbl, or 80g in a 20L homebrew batch) aromatic New World hops such as Citra, Mosaic, etc

### Fermentation

Lactobacillus brevis or other heterofermentative lactic acid bacteria

Ferment at 35°C for 24-48 hours or until the desired pH

For safety, wort pH must be below 4.5

Reboil, cool to lower than 15°C, and dry hop for 2-3 days

Cold crash and carbonate

Follow all other instructions and precautions for producing fermented NA beers

# ADDITIONAL CONSIDERATIONS

- Change Log (Document last updated January 2023):
  - We updated the temperature recommendation for NAY from 15-25°C to 20-25°C in January 2023 based on user feedback and experience. We find this improves the rate of success when using NAY.
  - Some recipes were modified slightly from their original versions published on our blog to reflect new opportunities in ingredients and processes.
- If using dark malts, stick with dehusked malts such as Carafa III or consider extracts such as Sinamar. We find that there is a high risk of astringency with dark malts in NA beers.
- Escarpment Labs is a provider of yeast cultures and the knowledge required to use yeast cultures. Purchasers of NAY and other maltose-negative yeasts accept all liability for the use of these products and must adhere to a Terms of Service agreement in order to purchase these products.
- All information contained herein is for educational purposes. Escarpment Laboratories is not liable for any damages resulting from the production of beer using these instructions or failing to use these instructions. Brewers are responsible for producing alcohol-free beers in accordance with the current state of knowledge surrounding food safety as well as all state, provincial, and federal food safety laws.