The Science of Brewing:

How 4 simple ingredients become the best beverage in the world

Part 3: **Water**

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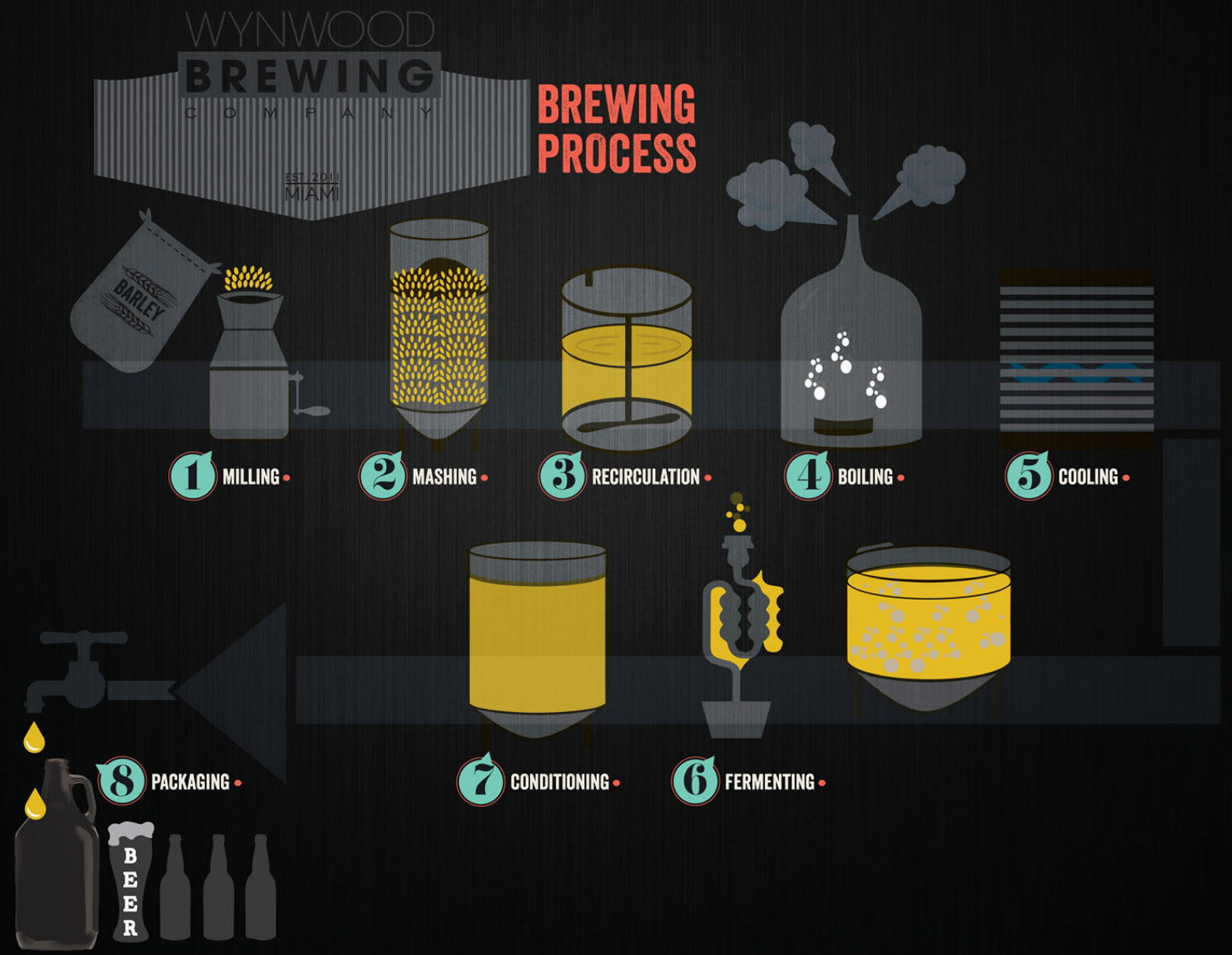
Introduction

Ingredients

1. Barley
2. Hops
3. Water
4. Yeast


WYNWOOD
BREWING
COMPANY
EST. 2011
MIAMI
BREWING PROCESS
BARLEY
1 MILLING
2 MASHING
3 RECIRCULATION
4 BOILING
5 COOLING
8 PACKAGING
7 CONDITIONING
6 FERMENTING
BEER

Disclaimer

1. I am not an expert

Water

Water

Water

- Beer is $\approx 95\%$ water
- Water is flavorless; ions aren't

Ions and their effect

Calcium

The most important ion in brewing!

- $Ca^{+} + Ph[x] \rightarrow precipitate + H^{+}$
- low pH important for mash enzymes

Magnesium

- $Mg \rightarrow happyyeast$:)
- Can give off-flavors in excess

Sodium

- accentuates flavor
- perceived sweetness
- off flavors when ossociating with sulfate ions

Potassium

- adds saltiness
- can inhibits mash enzymes

Sulpher

- Helps starch degradation
- Helps protein degradation (clarity)
- Negatively affects hopping
- Adds crispness to flavor, but off flavors in excess

Phosphate

- buffers pH when mashing and boiling

Cholrides

- NaCl MgCl both add body and sweetness
- useful for stouts, porters, belgium styles

Carbonates

- Raises pH
- Less fermentable and cloudy
- Can be used to correct for mash acidity

Nitrates

- can reduce fermentation

Some examples

	Ca^{+2}	Mg^{+2}	Na^{+}	Cl^{-}	SO_4^{-2}	Alkalinity
Dublin	16	2	8	14	12	32 ($CaCO_3$)
Arlington	23	6	23	38	25	51 (HCO_3)
Boston	5	1	34	23	7	41 (HCO_3)
Limerick	130	20	14	25	20	437 (HCO_3)
Galway	240	11	15	32	22	334 (HCO_3)

What to do about it

Nitrates

- Chalk – Calcium Carbonate ($CaCO_3$) – boosts alkalinity for brewing dark beers
- Baking soda – Sodium Bicarbonate ($NaHCO_3$) – boosts alkalinity and ammend sodium
- Gypsum – Calcium Sulfate ($CaSO_+4 * 2H_20$) enhances hop bittering
- Calcium Chloride ($CaCl_2 * 2H_20$) – ammend low chloride water
- Epsom salt – Magnesium Sulfate ($MgSO_4 * 7H_20$) – enhances hop bittering; use Mg sparingly if at all.

Today's Brew

Christmas Ale

Malt

- 5kg Irish Pale Malt (4-6)
- 1kg Crystal 30 (5)
- 500g Cara Special X (20)

Yeast

- Safale T-58
- Wyyeast Belgium Ale

Protein rest 10 mins at 58°. Mash for 30 minutes at 63 °. Mash for 30 minutes at 65 °. Hot crash/sparge with 8 liters at 75°. Boil 70 minutes. Target gravity: 1.072.

Hop Additions:

- 60mins 50g Hallertauer and Sonnet
- 25g juniper berries
- flameout Hallertauer and Sonnet
- (...more juniper?)