

The Science of Brewing:

How 4 simple ingredients become the best beverage in the world

Part 3: Water

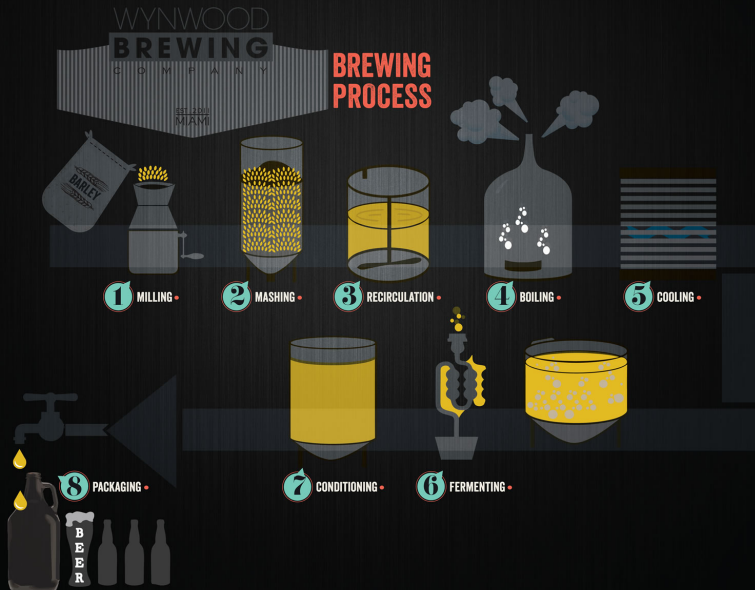
Nick Waters

Department of Microbiology
School of Natural Sciences
National University of Ireland, Galway

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Ingredients

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



Disclaimer

1 I am not an expert

Water



Water

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

Calcium

The most important ion in brewing!

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

Magnesium

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

Sodium

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

Potassium

- adds saltiness
- can inhibit mash enzymes

Sulphur

- 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

Chlorides

- 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)

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 ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) enhances hop bittering
- Calcium Chloride ($\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$) – ammend low chloride water
- Epsom salt – Magnesium Sulfate ($\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$) – enhances hop bittering; use Mg sparingly if at all.

Christmas Ale

Malt

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

Yeast

- Safale T-58
- Wyeast 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?)