The Use of κ-Carrageenan extracted from Seaweed in Brewing

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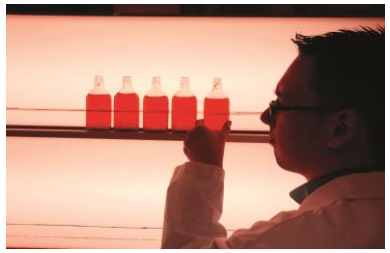

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www.murphyandson.co.uk

Who are we?

In the heart of the UK and present all around the world

Murphy & Son Ltd.

- Since 1887 supplier and manufacturer of

  liquor treatments and processing aids

  ingredients, refinements, hygiene products

  manual handling equipment
- Strong technical support
- UKAS accredited laboratory, Quality Control
- Research & Development
- Trouble shooting!

- **Passionate about beer and the industry!**

About Us

Customer Profiles

We work with some of the biggest names in the industry

Improve- Quality of the Product or Process

Reduce-Waste, Energy & Emissions

Save- Time and Money

Our distributors

World wide Distribution

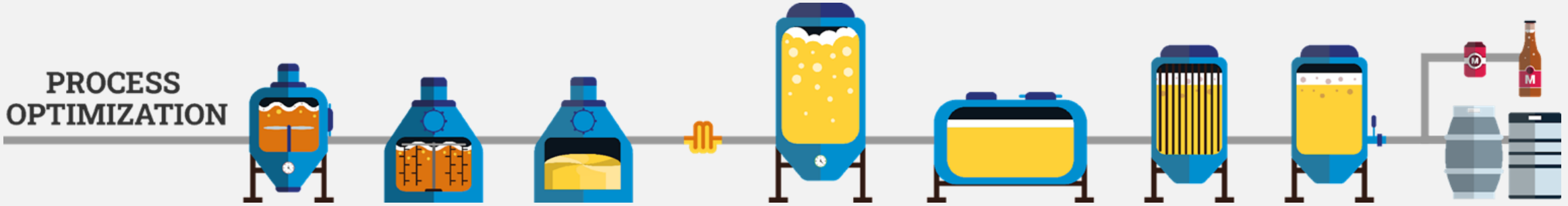
- HQ in Nottingham, UK
- Office in Krakow (Poland) & Massachusetts (USA)

Worldwide network of trusted partners stretching across twenty countries and five continents

…to provide brewers with the same quality products and service no matter their location.

MURPHY & SON

Product range

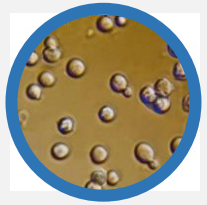


Liquor treatments & Raw materials

Stabilisers

Clarifiers

Foam-Enhhancers



Yeast & Nutrients

Enzymes

Finings

Foam control

Laboratory Services

MURPHY & SON

Carrageenan – Clearly a good idea!

- Wort and subsequent beer clarity is still of importance to the brewer/consumer

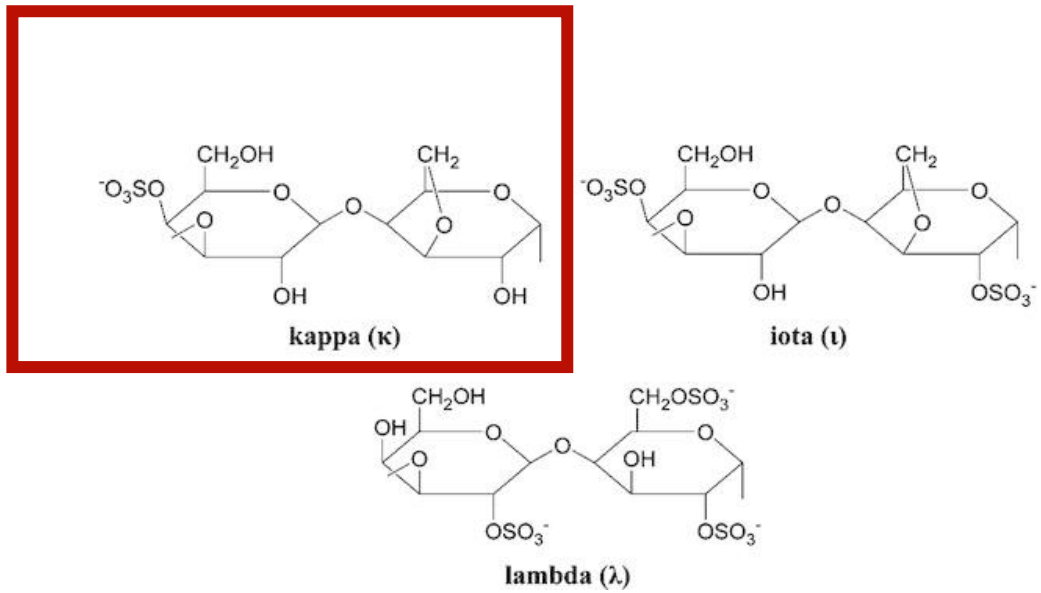
- **Even for beer styles where a certain level of haze is accepted/expected**
  - **Understanding and control is critical!**

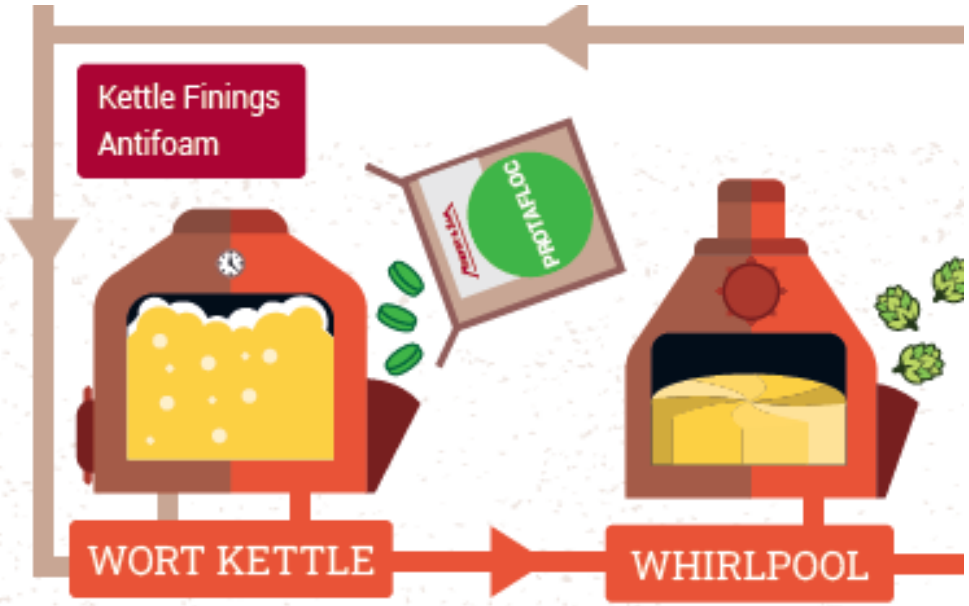
It all starts with the raw materials

- Clear beer starts even before the brewhouse with the selection of raw materials
  - E.g. ↑ nitrogen and polyphenol levels will inevitably produce beers which are difficult to clear and, after packaging, will be prone to **colloidal instability.**
  - Some cereal adjuncts (e.g. wheat) ↑ ↑ ↑ protein to the wort which will induce turbidity

Carrageenan – Clearly a good idea!

- Carrageenan = family of functional biopolymers and is found in many species of red seaweeds
- Family of polysaccharides with a high molecular mass (400 to 600 kDa)
- mainly categorized into three different classes based on their sulfate content
  - **κ-carrageenan (one sulfate group per disaccharide) has proven to be the most interest to the brewing industry**





Carrageenan

.. To improve wort clarification

- brighter wort, improved fermentation
- Improves colloidal stability
- Increases wort clarification and faster filtration
- Reduce process time
- reduces the amount of finings required later (e.g., diatomaceous earth (DE))
- Improve beer stability and healthy yeast
- **Processing aid, not an additive (does not require label declaration)**

Wort clarification – k-carrageenan

- Natural product!

- Derived from Seaweed!

  - such as ***Eucheuma spp.,*** *Chondrus crispus* (Irish Moss) or *Gigartina spp*
  - *Irish Moss -> Atlantic seaweed*
  - *Pacific seaweed (Eucheuma spp.)*

  has a ***higher concentration of k-carrageenan!***

Carrageenan – The general principle

- **The first point at which finings technology can be applied to assist the brewer is in the kettle!**
  - Negatively charged carrageenan dissolves into boiling wort
  - Binds to positive charged protein in cold break as it forms
  - Resulting particles are relatively large and sediment and fall to the bottom of the fermenting vessel
    - → Removes excess protein as wort cools

$$V = \frac{2}{9} \frac{(\rho_p - \rho_f)}{\mu} g R^2$$

Watch the magic happen

- Murphy and Son produce a range of kettle fining agents specifically designed for brewers to remove cold break proteins, applied at 10 to 50ppm to the hot wort.

Control vs 30ppm Kettlekleer after 3 hours in 20°C wort

Carrageenan options

- **Granules or Tablets**

- **semi-refined or refined (= impurities removed)**

- **High quality – low dosage rates!**

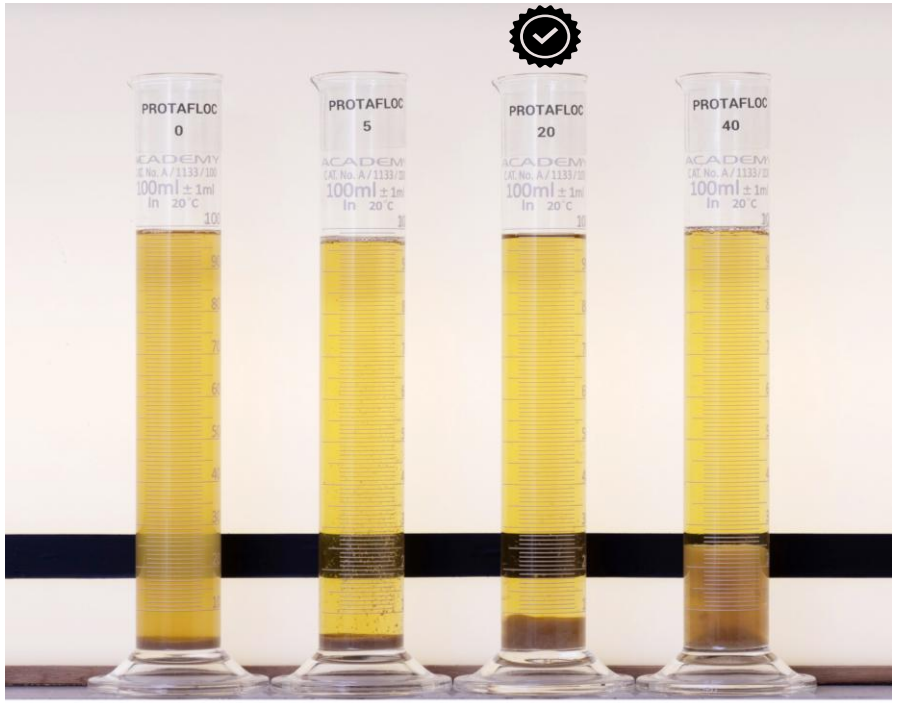
Carrageenan options

- **Koppakleer – Granules or Tablets**
  - Refined (unwanted impurities removed) – Used for difficult worts or to use in the whirlpool

- **Protafloc or Kettlekleer – Granules or Tablets**
  - Semi refined - suitable for most worts
  - **Extremely low addition (1-4 g/hl) – determined via optimization trials**

Kettle finings in use

Require optimization trials!



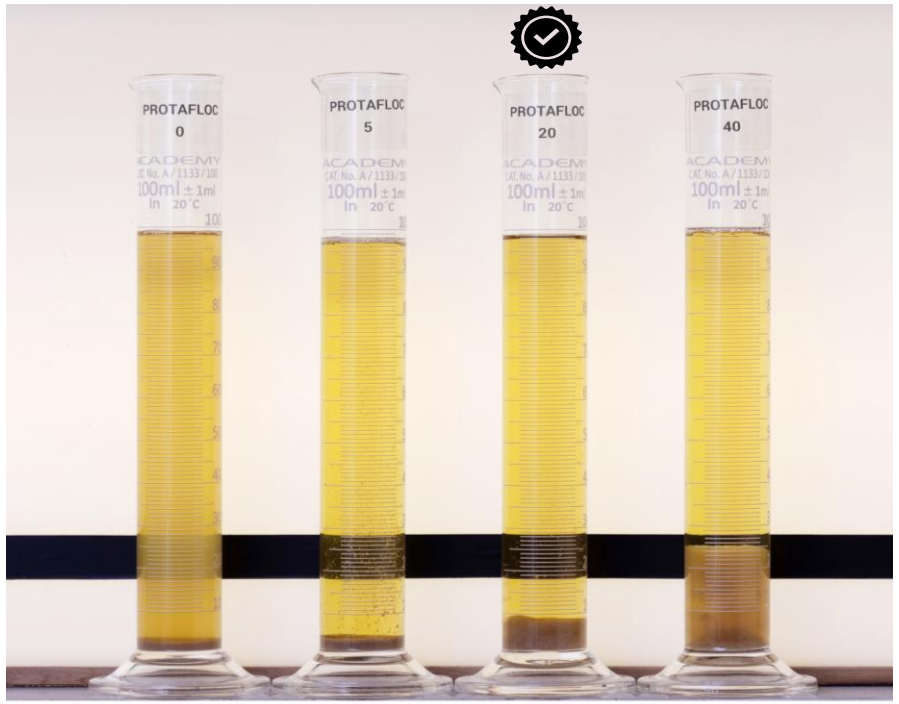
- Granular κ-carrageenan **(Protafloc; *Eucheuma spp*.)** added to measuring cylinders at 0-40 ppm (Fig. 2)
- Wort sample taken 15 min before the end of boil

Control - Mini-sediment with hazy wort

5 ppm - Sediment but slightly hazy wort - underfined

20 ppm- Clear wort, packed sediment → optimum!

40 ppm - Very loose sediment, clear wort - overfined



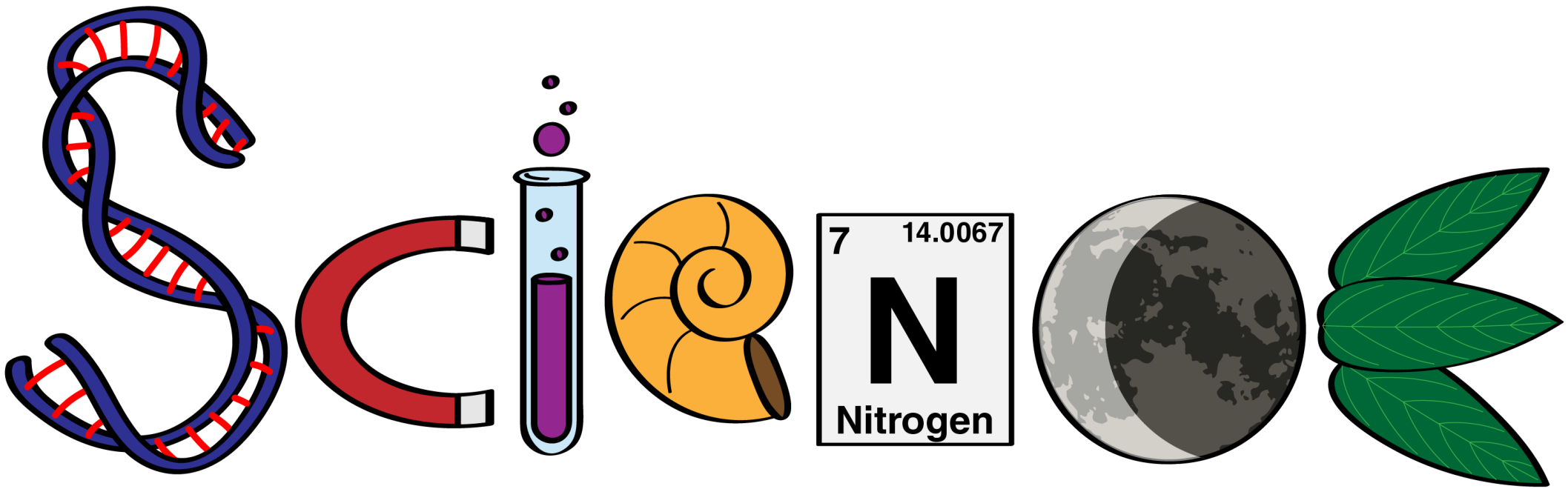
If dose rate increases, clarity improves

But the level of sediment increases

= beer losses

How often should they be performed?

New recipes
New seasons malt
New equipment in brewhouse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ASBC
THE SCIENCE OF BEER

A-16

The Use of κ-Carrageenan extracted from Seaweed in Brewing

Impact on Beer Clarity, Filtration Performance and Colloidal Stability

2022 ASBC Meeting
BREWING SUMMIT 2022
Providence, Rhode Island | August 14–16

Celina Dugulin

Murphy & Son Ltd., Nottingham, UK

Introduction

Kappa-carrageenan is derived from red seaweeds (Figure 1) and has long been used for wort clarification in the brewing industry (copper or kettle finings). The active ingredient, negatively charged κ-carrageenan, dissolves easily into boiling wort and complexes with the positively charged protein fraction. The resulting particles are relatively large, flocculate and fall to the bottom of the fermenting vessel, helping to remove excess protein as the wort cools. The present study aims to review and extend previous research on the brewing application of carrageenan derived from different seaweeds, such as ***Eucheuma spp.***, *Chondrus crispus* (Irish Moss) or *Gigartina spp.*

Keywords: Carrageenan, seaweed, colloidal stability, wort clarification

Fig. 1: red *Eucheuma spp. seaweed*

Optimisation trials (0-40 ppm) to avoid over- or underfining

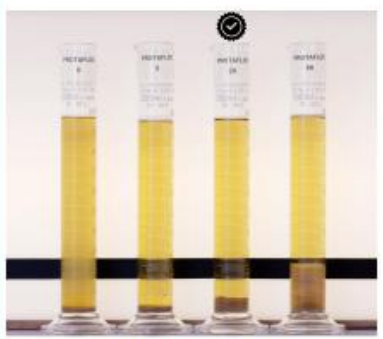

Fig. 2: Optimisation trials

- Granular κ-carrageenan **(Protafloc; *Eucheuma spp.*)** added to measuring cylinders at 0-40 ppm (Fig. 2)
- Wort sample taken 15 min before the end of boil

Control - Mini-sediment with hazy wort

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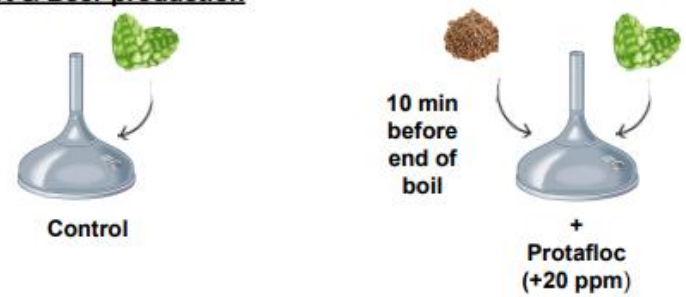
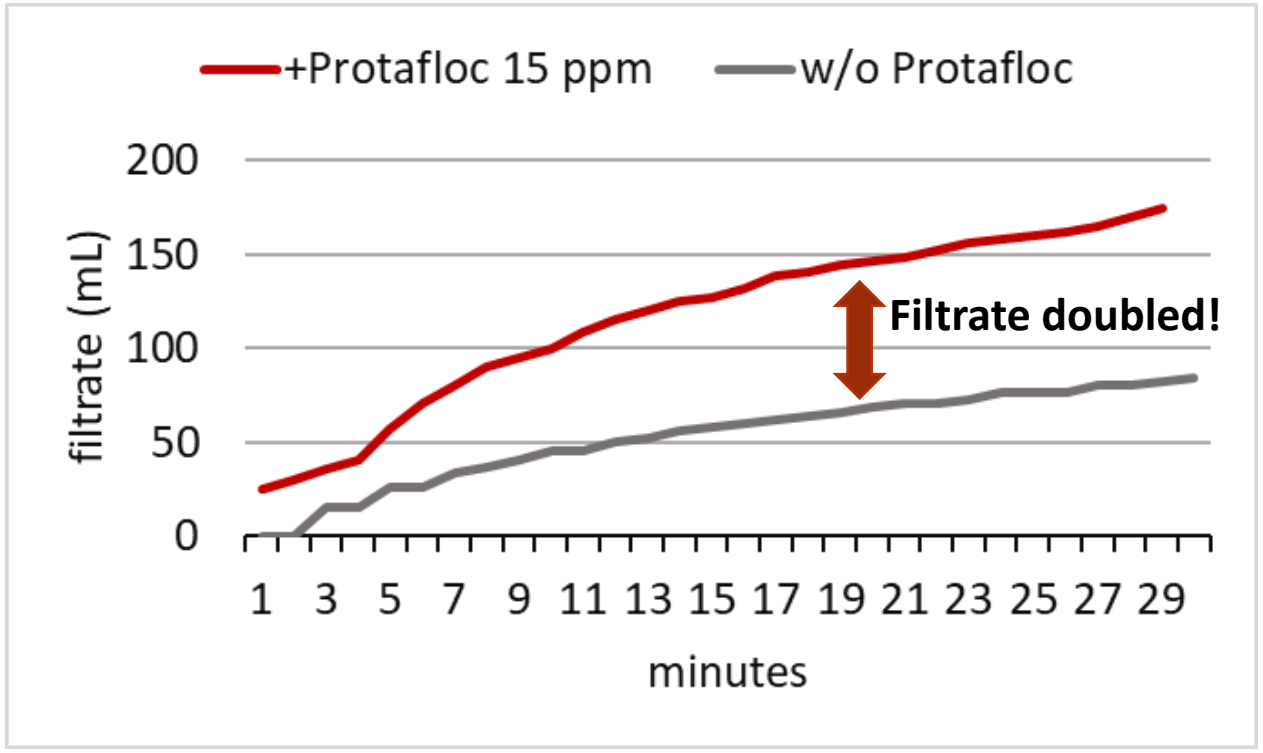
Wort & Beer production



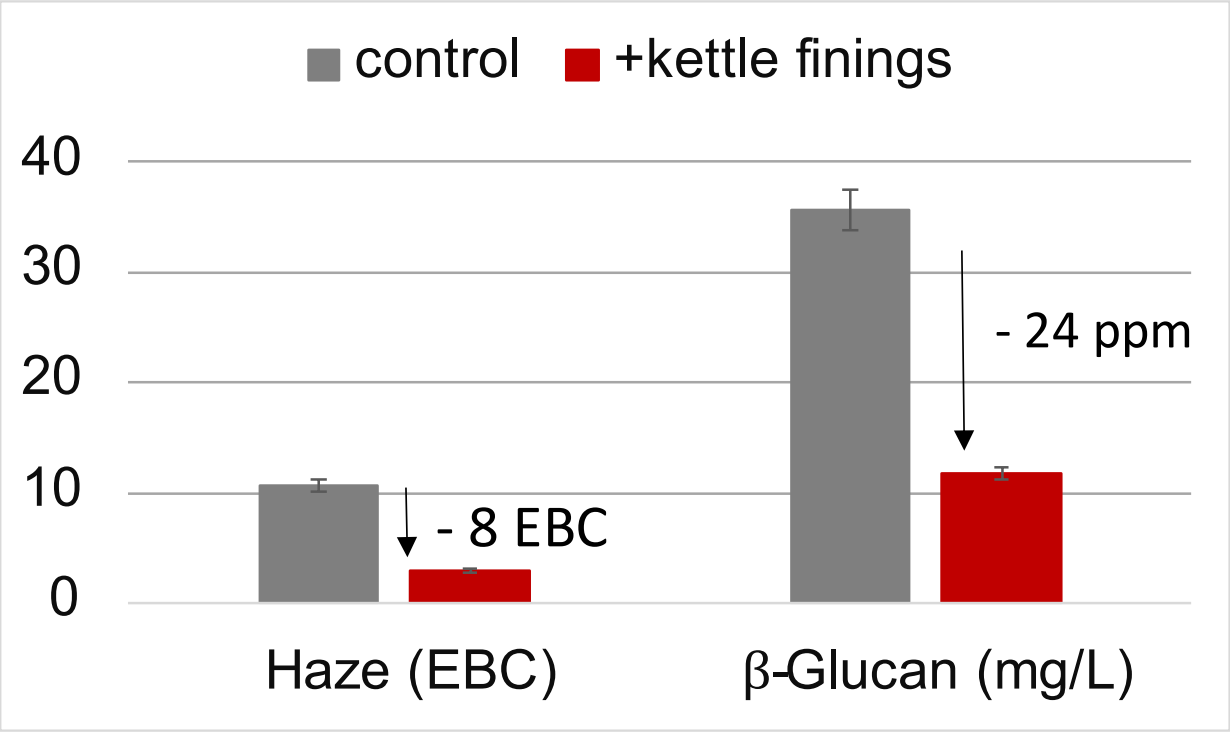
Beers were brewed using 100% pale ale malt, utilising a 30l all-grain brewing system; mashed in at 62°C, pH 5.3 at a liquor:grist ratio of 3:1. The wort was boiled for 60 min, and fermented at 20°C (SafAle SO-4), using temperature controlled, conical fermenters with or without the addition of Protafloc (n=3). Beers were bottle conditioned (7 days) and then stored at 4°C until analysis.

Beer filtration



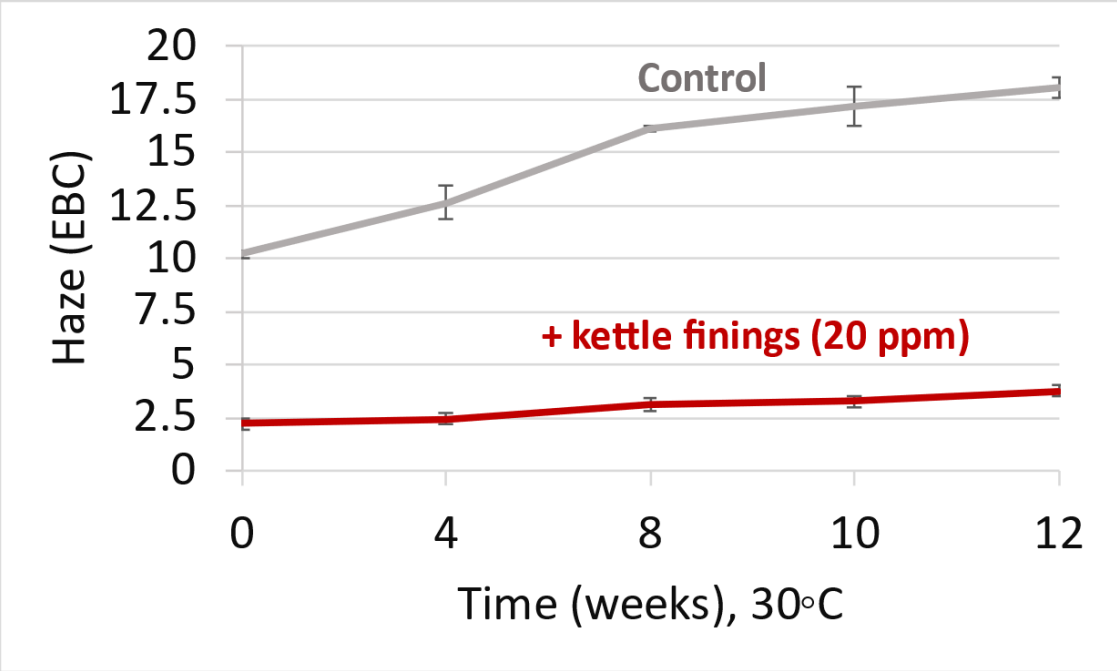
- Beer filtration rate was significantly improved when Protafloc was added to the wort in the kettle.

Beer haze



- Lower haze (<3 EBC) levels were measured in unfiltered beers brewed with the addition of Protafloc
- Removal of ß–Glucans were significantly enhanced

Colloidal stability



Chill haze measured over time in beers kept in the dark at 30◦C

- All control beers showed a significant increase in chill haze formation, while kettle fined beers measured haze levels <5 EBC even after 12 weeks kept at 30◦C

Wort clarification – carrageenan

In summary

- Natural & food-grade
- Carrageenan are derived from Seaweed from the Philippines.
- We sell refined (Koppakleer) and semi refined (Protafloc) carrageenan
- Both types comes in granular and tablet form
- Brewers need to optimise their wort before determining their correct dosage rate
- They are added to the boil to dissolve and disperse
- They bind to positive charged protein in cold break as it forms
  - Creates brighter wort, improves fermentation and causes a faster filtration
  - improves colloidal stability
  - reduces the amount of finings required later (e.g., diatomaceous earth (DE))

Questions?