The Use of κ-Carrageenan extracted from Seaweed in Brewing

Impact on Beer Clarity, Filtration Performance and Colloidal Stability

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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.*

Fig. 1: red *Eucheuma spp. seaweed*

Keywords: Carrageenan, seaweed, colloidal stability, wort clarification

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

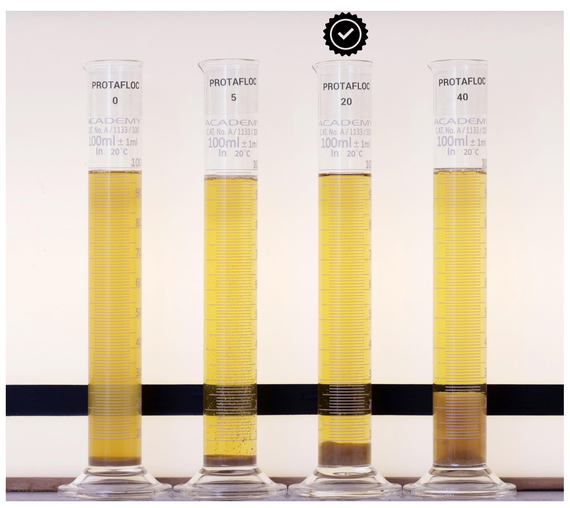


Fig. 2: Optimisation trials

- 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

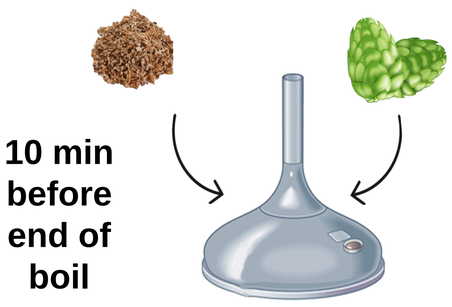
5 ppm - Sediment but slightly hazy wort - underfined

20 ppm- Clear wort, packed sediment → optimum!

40 ppm - Very loose sediment, clear wort - overfined

Wort & Beer production

Control



+ Protafloc (+20 ppm)

Beers were brewed using 100% pale ale malt, utilising a 30l all-grain brewing system; mashed in at 62℃, pH 5.3 at a liquor:grist ratio of 3:1. The wort was boiled for 60 min, and fermented at 20℃ (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℃ until analysis.

Results & Discussion

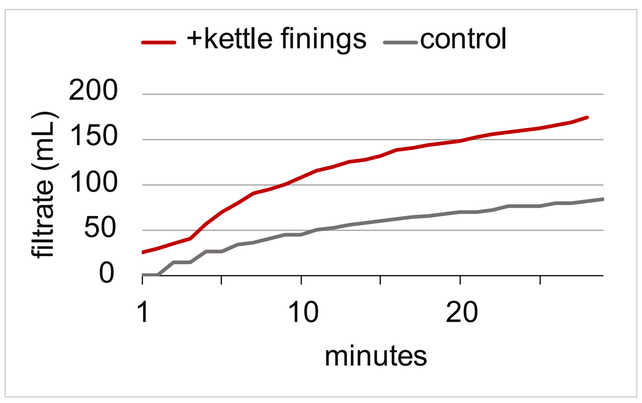


Fig. 3: Filtration rate of beers with or without addition of semi-refined carrageenan

Fig. 4: Comparison of beer haze and β-glucan levels in finished fresh beers

- Incorrect addition of copper finings (both over and under) can give poor fining action (Fig.2)
- The **optimum rate** of addition of finings (lowest haze & compact sediment) should be determined annually when starting the new season's malt or whenever there is a change in the type or supplier of malt to avoid under or even over-fining.
- Lower haze (<3 EBC) levels were measured in unfiltered beers brewed with the addition of Protafloc, compared to the control beers (10.8 ± 0.7 EBC; Fig.4)
- Removal of ß–Glucans were significantly enhanced (Fig. 4) and filtration rate was improved, with 4-times more volume filtered within 10 minutes compared to the control beers (Fig.3)
- 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 (Fig.5)

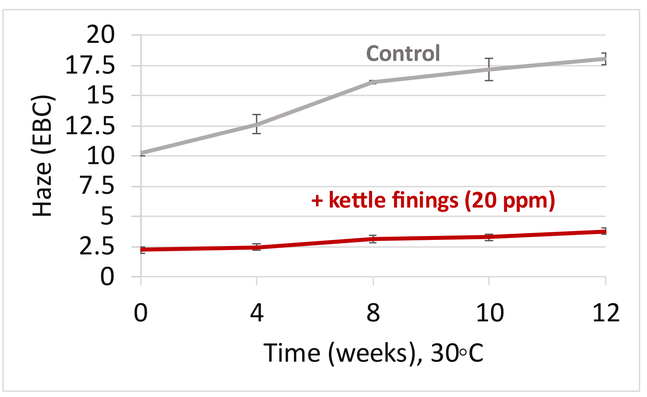


Fig. 5: Chill haze measured over time in beers kept in the dark at 30◦C

Conclusion

Adding small amounts of carrageenan at the late stage of boiling or directly into the whirlpool (semi-refined & refined grade, respectively) can help to produce brighter worts, increases filter run length, improves colloidal stability and reduces the amount of finings required later (e.g., diatomaceous earth (DE)). Thus, the addition of kettle fining has been shown to enhance the quality of the finished beer and improve process efficiency. Future work should further attempt to quantify the effect of these benefits as brewers become increasingly economically and environmentally conscious.

References

Fratianni, A. & Sammartino, M. Carrageenan and Its Brewing Application. MBAA TQ, 2017; 54, 157-160.

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