

Filtration, haze and foam characteristics of fermented wort mediated by yeast strain.

P Douglas¹, Dr J Meneses², and Dr V Jiranek¹

¹University of Adelaide, Adelaide, SA, Australia, and ²Coopers Brewery, 461 South Road, Adelaide, SA, Australia)

Introduction

The first things that customers notice about their beer are the clarity and the head on top of that beer. The clarity of wine is also a crucial quality criterion, as is the head retention of sparkling wines. Filtration is the process used by many brewers and wine makers to achieve clarity of their product, and this process is both a significant cost in the production, and also can directly influence the head retention, as well as other parameters such as flavour. The causes given in publications for differences in filtration behaviour of different batches are usually concerned with the raw materials. The discovery in this laboratory of the widespread occurrence of secretion of invertase and other proteins into the medium by yeast strains and the variation in this trait led to measurement of the extent to which the choice of yeast strain affects the filterability of the fermented product and the haze and head retention potential in the filtered product. (Douglas et al. 2006)

Materials and Methods

Beer was made under laboratory conditions using hopped malt extract and fermented using a number of strains of brewers', bakers', distillers' and laboratory yeast. The yeast strains were also grown up on a chemically defined medium (Kennedy et al. 1997) containing a supplement which enhanced the secretion into the medium of invertase and other proteins. After a period of maturation this was filtered using filterability test equipment (Esser 1972). The V_{max} of the beer was measured, and the initial haze and haze shelf-life of the beer was measured ((Analytica-EBC/European Brewery Convention, 1998) method 9.30). The head retention value for the fermented products was also investigated using the Rudin (Rudin 1957) apparatus.

Yeast strains used in this study.			
Strain	Comments	Strain	Comments
CBL 1B	Brewing (ale)	Mauri MD1	Baking
Danstar London	Brewing (ale)	Mauri MD2	Baking
Danstar Windsor	Brewing (ale)	Mauri P1	Baking
NCYC 1157	Brewing (ale)	Mauri P2	Baking
NCYC 1245	Brewing (ale)	Mauripan	Baking
NCYC 1309	Brewing (ale)	ATCC 60868	Distilling
NCYC 1681	Brewing (ale)	Danstil A	Distilling
NCYC 240	Brewing (ale)	Danstil B	Distilling
Birrel	Brewing (lager)	S288c	Laboratory
NCYC 1324	Brewing (lager)	W303	Laboratory
R111	Brewing (lager)	AWRI 350	Wine
R112	Brewing (lager)	AWRI 796	Wine
Safbrew S189	Brewing (lager)	AWRI 835	Wine
Safbrew S33	Brewing (lager)	EC 1118	Wine

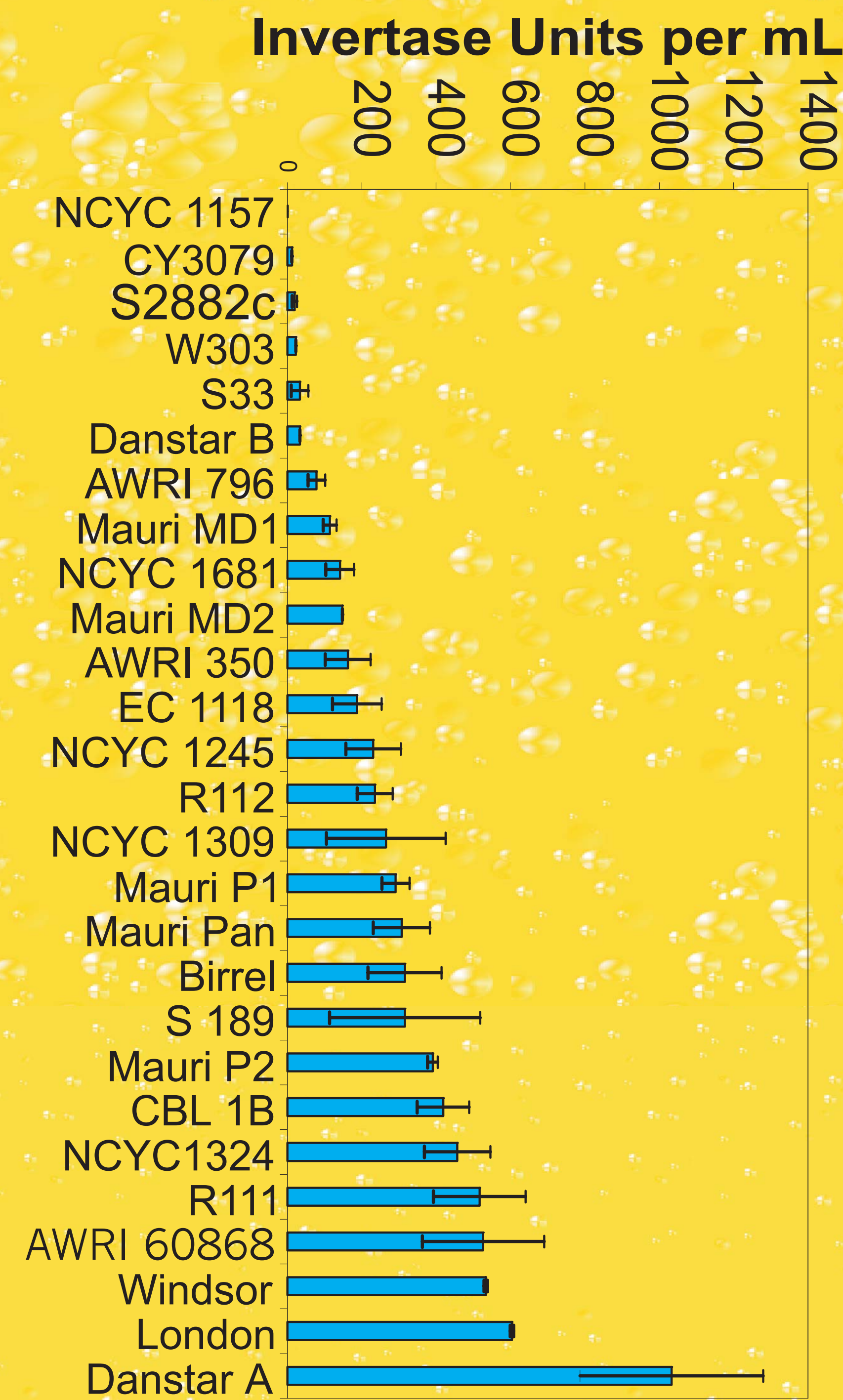


Fig. 1

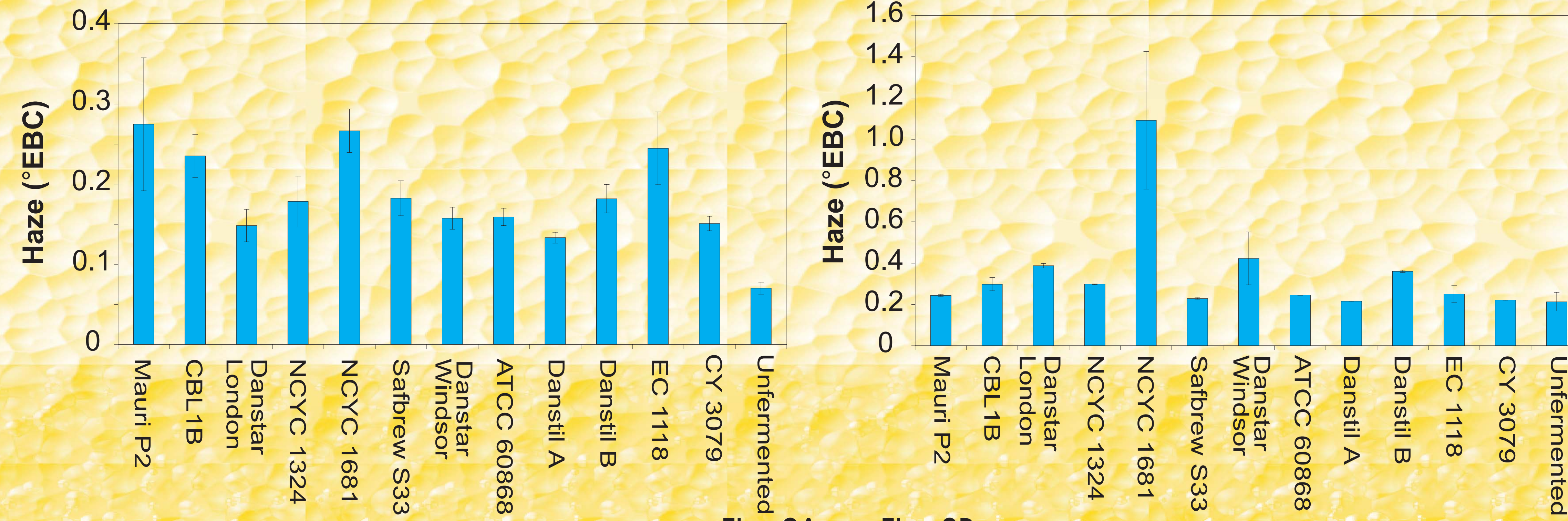


Fig. 2A

Fig. 2B

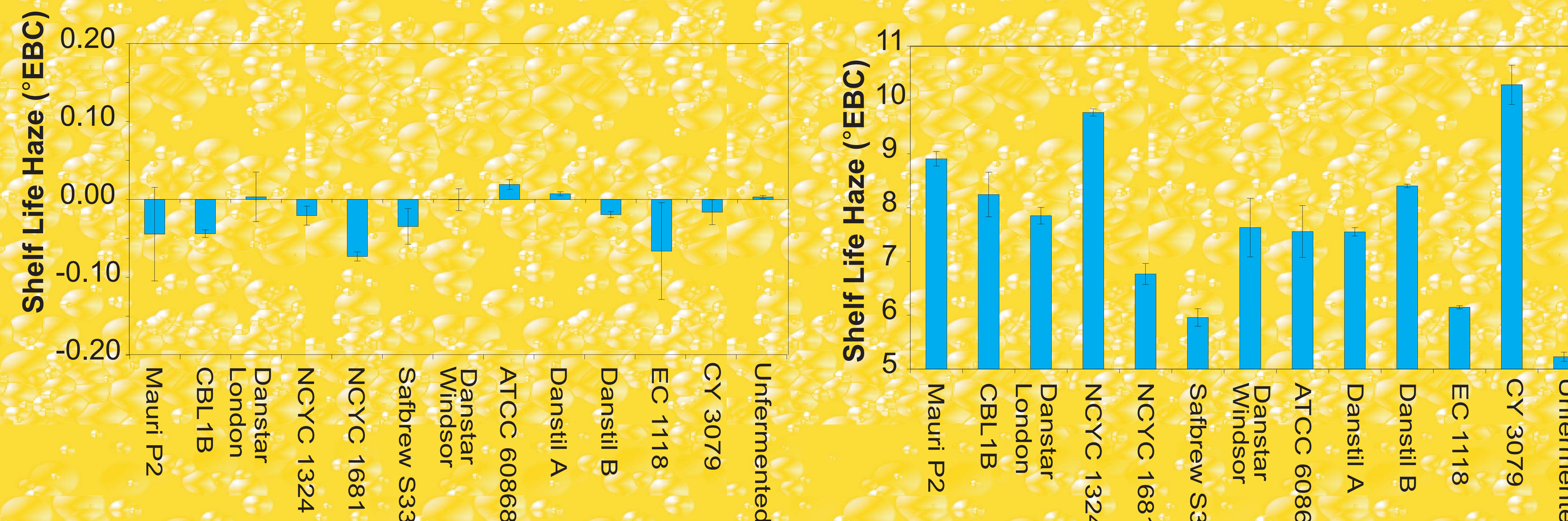


Fig. 3A

Fig. 3B

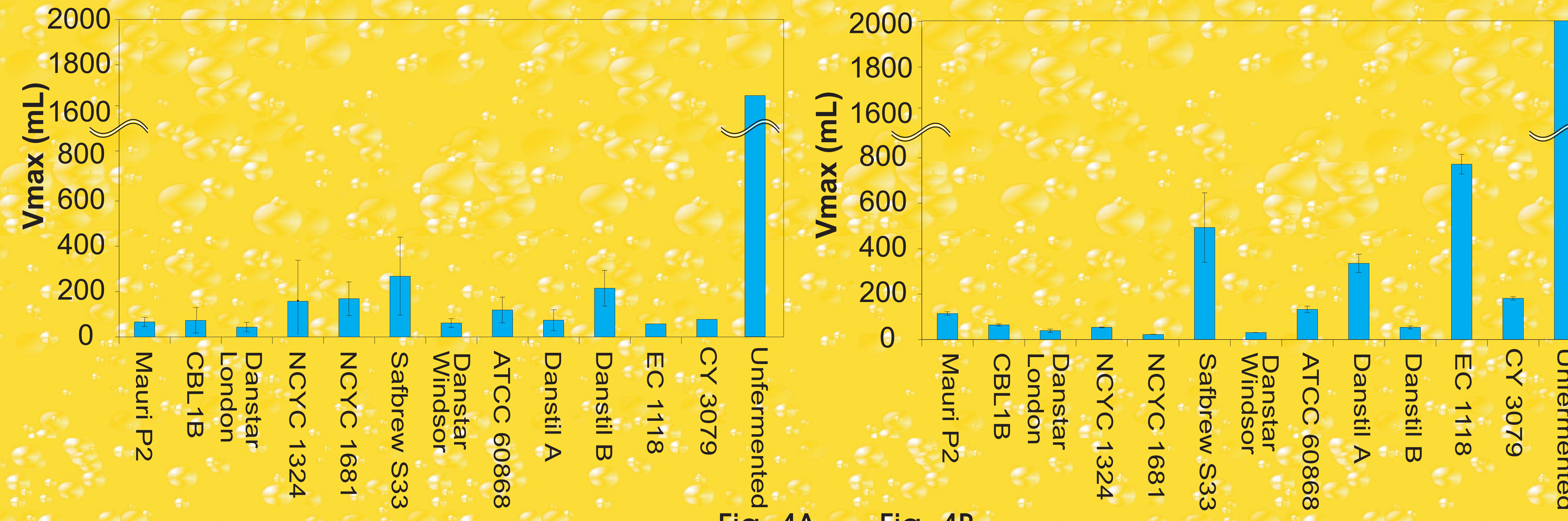


Fig. 4A

Fig. 4B

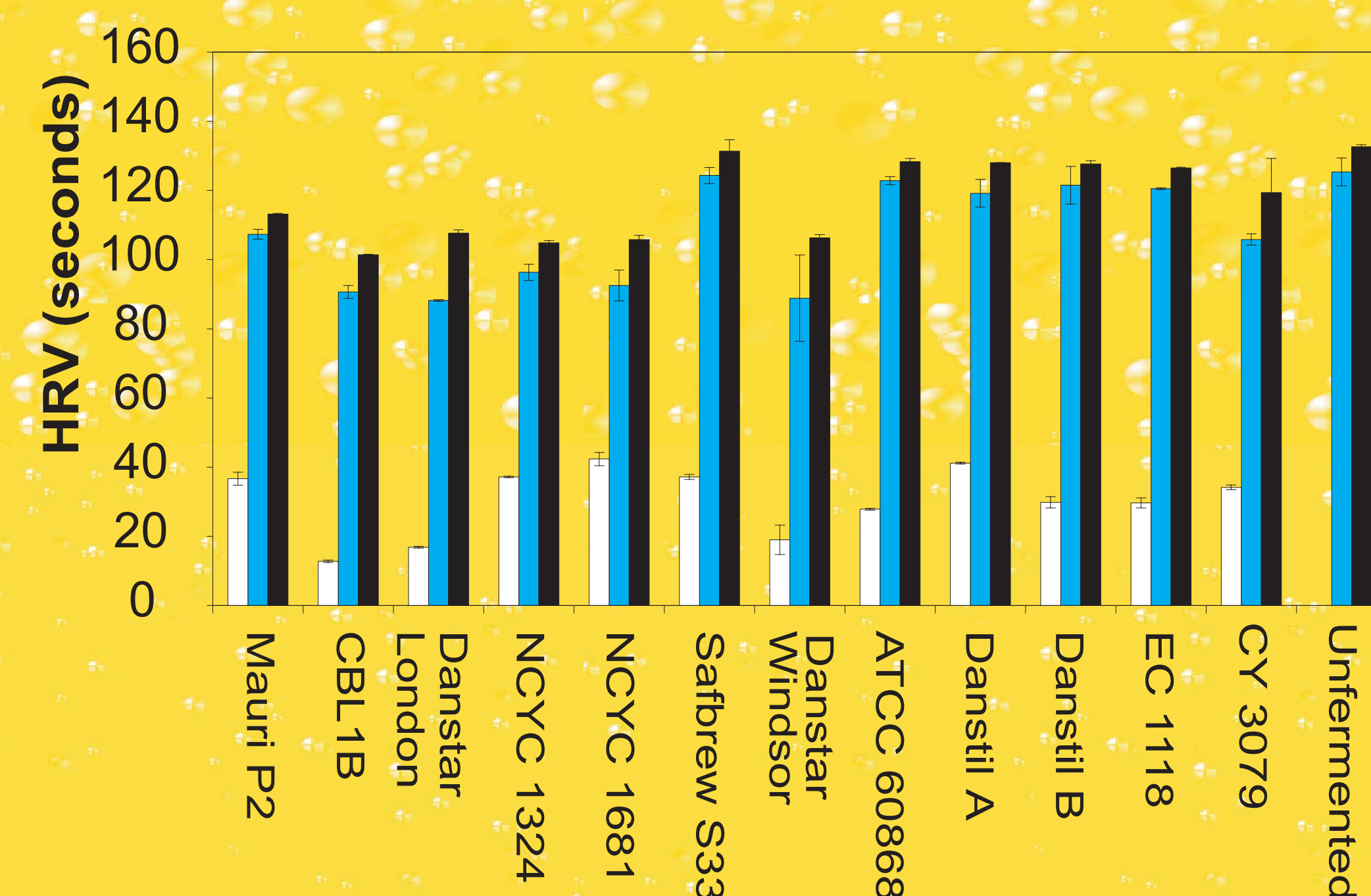


Fig. 5

Head Retention

The head retention of the unfermented synthetic medium was too low to be measured by the Rudin method (White bars). However head retention values of the fermented CDWS were found to be higher (Fig.5). Conversely, head retention values of fermented ale wort (blue bars) did not exceed that of the unfermented medium. These values were reduced by up to 30%. While a clear strain dependence was observed, the head retention values seen for a given strain were poorly correlated across the two media used. The strains were also used to ferment a stout wort (black bars). Head retention values were found to be highly correlated when comparing the two fermented worts.

Results and Discussion

An earlier observation by this group (Meneses et al. 2002) observed a wide variation in the tendency of commercial yeast strains to secrete invertase into the medium (Fig 1). We have shown in this laboratory that the mannoprotein invertase can protect beer against the formation of haze in force testing experiments (data not shown), as shown for wine (Dupin et al. 2000). Following from these findings we examined the haze potential of beers fermented with yeast strains that had differing tendencies to secrete invertase. In order to do this it was necessary to filter these fermented products. This laboratory scale filtration indicated that the ease with which the products could be filtered varied with the yeast strain chosen, and so an investigation of the filterability was also conducted. We additionally examined the head retention of the products.

Haze

Fermented and filtered CDWS supernatants varied in their initial haze value but all were greater than the unfermented control (Fig. 2A). Initial haze values increased by an average of 2.7-fold from the unfermented control. In the case of ale wort (Fig. 2B), the unfermented control produced an initial haze value of 0.21°EBC, most fermented samples produced values between 0.2 and 0.4°EBC. The supernatant of ale wort fermented by strain NCYC 1681 was a marked exception and attained a value of 1.1°EBC.

Shelf-Life Haze

After the lagered ferments had been filtered into sealed vessels and left on ice overnight they were analysed for initial haze. The initial haze values were subtracted from a second turbidity reading taken after holding the supernatants at 60°C for 48 hours and then overnight on ice. Haze in the unfermented CDWS did not change post-forcing. Values for the fermented CDWS samples varied with yeast strain and were typically less than the initial haze value (Fig. 3A). Only strains ATCC 60868 and Danstil A showed an increase in haze, albeit modest, during the shelf-life assay. Contrasting strongly with these findings, fermented ale wort was observed to dramatically increase in haze after forcing (Fig. 3B). The unfermented control displayed a shelf-life haze value, which was c. 25-fold higher than the initial haze value. For fermented ale wort, the shelf life haze values were between sixfold (NCYC 1681) and 47-fold (CY 3079) greater than the initial values.

Filterability

Filterability of both unfermented media was comparable, with a V_{max} of the order of 2000 ml. Values for fermented supernatants were highly variable but were reduced across all the strains tested. For the CDWS (Fig. 4A), filterability was most often reduced to a V_{max} of <200 ml with the lowest value being seen for Danstar Windsor and the highest, Safbrew S33. Fermentation of ale wort (Fig. 4B) resulted in filterability values ranging from 22 ml for NCYC 1681 to 773 ml for EC 1118. No clear relationship between the values recorded across the two media was apparent.

Conclusion

Although the primary cause of filtration, haze and head retention influences will be due to raw material considerations, the strain of yeast used in a ferment will also influence these parameters.

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