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Quality potential of a New Canadian Hulless Malting Barley Variety CDC Clear

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Introduction

CDC Clear is a new 2-rowed hulless malting barley variety developed by the University of Saskatchewan. It is a good yielder and has fair to good resistance to lodging, shattering, straw breakage and drought, as well as good resistant to True Loose Smut. The malting trials conducted at CMBTC exhibited its overall malt quality potential which is comparable to the 2-row regular malting varieties, but with exceptionally higher extract yield. Despite the availability of this hulless barley variety and its exceptional malt quality potential, commercial brewers remain skeptical due to potential processing concerns with wort separation without the availability of a mash filter or other ways of separating the wort from the mash. In this study we demonstrated that CDC Clear malt can be utilized in the brewing process using a regular lauter tun for wort separation. In addition, CDC Clear malt's brewing performance and beer quality were evaluated against regular commercial 2-rowed pale malt.

Experiment

Malting Trials:
The hulless malt was produced at CMBTC using the 100 kg pilot malting system with a CDC Clear barley sample collected from Saskatchewan, Canada during 2015 harvest.
The regular malt was a commercial pale malt (2-rowed) obtained locally.

Brewing trials:
The brewing trials were conducted at CMBTC using a 3hL pilot brewing system. All-malt brews were conducted in duplicate (except for 100% hulless) using 100%, 50%, 30%, and 0% of the hulless barley malt supplemented with 0%, 50%, 70%, and 100% of the regular barley malt, respectively. All brews were conducted under CMBTC's standard conditions. The process procedures for all the brews were kept identical, except for the wort separation. The 50%, 30%, and 0% hulless brews utilized a lauter tun for wort separation, while the 100% hulless brew utilized a Mura mash filter.

Results and discussion

Table 1. Final malt analysis.

Parameter	Malt moisture, (%)	Friability (%)	Fine extract (%)	Coarse extract (%)	F/C difference (%)	Soluble protein (%)	Total protein (%)	Kolbach index (%)	Beta-glucan (ppm)	Viscosity (cps.)	Diastatic power (°L)	α-Amylase (D.U.)	Wort colour (SRM)	Wort pH	FAN (mg/L)
CDC Clear	4.80	76.0	88.2	86.2	2.00	4.59	11.13	41.2	217	1.57	142	69.6	2.05	5.76	208
Commercial pale 2-row	4.65	89.6	81.4	80.6	0.85	4.15	11.19	37.1	97.0	1.48	134	53.3	1.22	5.97	146

Malt analysis indicated that the CDC Clear barley produced malt suitable for brewing with comparable qualities to the commercial pale 2-row malt. Although the CDC Clear malt had a lower friability, higher beta-glucan content and viscosity; higher FAN, α-Amylase, and diastatic power were observed (Table 1).

Table 2. Brewhouse performance.

Parameter	Conversion time (min.)	Time to clear (min.)	Imhoff cone (mL)	Brewhouse efficiency (%)	Wort pH	Wort colour (SRM)
0% CDC Clear	20	6	0.75	90.1	5.43	2.41
30% CDC Clear	17.5	6.5	0.65	87.7	5.28	3.08
50% CDC Clear	17.5	7	1.63	87.6	5.21	3.39
100% CDC Clear	26	-	-	93.1	5.11	5.16

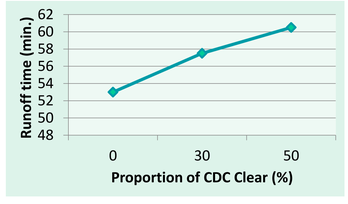

Figure 1. Runoff times using CDC Clear in a lauter tun

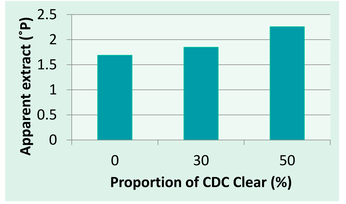

Figure 2. Last runnings using CDC Clear in a lauter tun

Processing of the beers in the brewhouse using 30% and 50% CDC Clear revealed no significant differences compared with the 0% CDC Clear brewed with the hulled commercial 2-rowed pale malt (Table 2). A shorter conversion time for the brews which utilized CDC Clear malt and a lauter tun was observed. Time to clear to less than 100 FTU during vorlauf slightly increased as ratio of CDC Clear malt increased. This also correlated with increased values measured in the Imhoff cone. As ratio of CDC Clear increased, an increase in runoff time was observed (Figure 1). An increase in the last running's apparent extract was observed as the ratio of CDC Clear malt increased (Figure 2). This indicated a higher extract potential of CDC Clear compared with the commercial hulled malt. To utilize the CDC Clear malt to its full extract potential, an increase in sparge volume would allow for collection of the remaining sugars in the grain bed and yield a greater brewhouse efficiency than observed in this experiment. Overall, despite the greater beta-glucan content and higher viscosity in the CDC Clear malt, all brews utilizing the lauter tun performed similarly in the brewhouse with no problems experienced and very only slight differences observed during wort collection.

Table 3. Final beer analysis

Parameter	Apparent extract (Plato)	Real extract (Plato)	Alcohol (v/v %)	Color (ASBC)	pH	Foam (NIBEM)	Initial Turbidity (FTU)	Chill turbidity (FTU) 24 Hr
0% CDC Clear	1.73	3.57	5.07	2.94	4.16	236	15.4	17.4
30% CDC Clear	1.85	3.68	5.05	3.75	4.25	230	16.0	17.2
50% CDC Clear	1.91	3.76	5.08	4.27	4.23	237	16.3	17.5
100% CDC Clear	2.29	4.25	5.45	6.84	4.58	240	16.7	17.0

The beers produced from the brews all had similar foam stability and turbidity values (Table 3). Further studies are required to compare the colloidal stability of the beers. Apparent extract, beer colour and pH increased as ratio of CDC Clear increased. Wort analysis showed comparable wort sugar profiles, but with an increase in total sugar concentration as the ratio of CDC Clear increased (Figure 4). As shown in Figure 3, attenuation limit of the final beer decreased as the proportion of CDC Clear increased. Figure 5 shows an increase in both fermentable and non-fermentable sugar concentrations remaining in the final beers as the proportion of CDC Clear malt increased. Under-attenuation of the beers utilizing hulless malt has been observed in previous studies. It has been postulated that the requirement of zinc and calcium are not met in the final wort due to the absence of husk material in the grist. Further studies are required to fully understand the mechanism responsible.

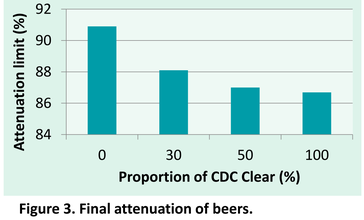

Figure 3. Final attenuation of beers.

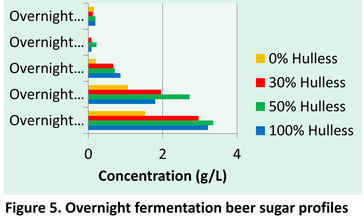

Figure 5. Overnight fermentation beer sugar profiles

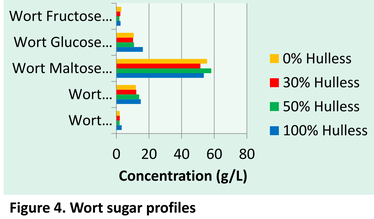

Figure 4. Wort sugar profiles

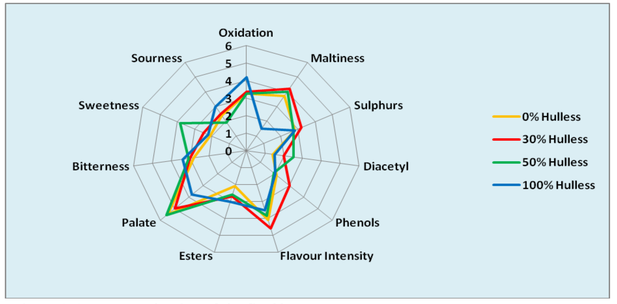

Figure 6. Sensory evaluation of the final beers

Sensory evaluation of the beers were performed by CMBTC's trained beer sensory panel. Evaluation indicated that beers produced with CDC Clear malt exhibited a comparable flavour profile to that of the 0% CDC Clear brew produced using the commercial 2-row pale malt. No major defects were observed in the final beers.

Conclusions

CDC Clear barley can produce malt comparable to commercial 2-row varieties with increased FAN and enzymes compared to regular barley malt as well as the potential for a superior extract yield. Even with a greater beta-glucan content and greater viscosity, wort separation using 30% and 50% CDC Clear malt can be carried out successfully using a regular lauter tun with only a minor increase in total runoff time. Satisfactory wort sugar profiles are produced with 100%, 50% and 30% blends of CDC Clear malt, respectively. Final attenuation of the beers produced with CDC Clear were lower than the hulled commercial 2-row pale malt. It is postulated that this could be a result of zinc and calcium deficiency from the lack of husk in the grist. Further studies are required to understand this phenomena. The beers generated using CDC Clear malt all showed flavor attributes comparable to the controls with no major defects detected.

Acknowledgements

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