WORT SEPARATION USING A SMALL SCALE LAUTER TUN APPARATUS

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ABSTRACT

In conjunction with barley breeding programs targeted at producing new varieties with high quality brewers malt capability, there is a requirement for a small scale lauter tun (SSLT) system to predict potential lauter tun performance. The SSLT could be applied to screen potential malting varieties prior to microbrewery trials. The SSLT has proven to be effective in discriminating between malts with various proportions of added under-modified malt. By gaining a complete understanding of the processes involved, malt characteristics that promote or retard lautering can be targeted within existing breeding programs to produce barleys more closely attuned to the needs of brewers.

INTRODUCTION

During the 1970s, several papers were published that described the development of increasingly sophisticated laboratory-scale lautering vessels. These were often of all-glass construction, and were designed to allow the assessment of a number of factors in apparatus that mimicked the salient features of brewery lauter vessels. For instance, Crabb and Bathgate (1973) and Bathgate et al (1975) reported the construction and operation of a combined mash and lauter vessel with a capacity of 1 kg malt. The equipment incorporated a host of control units and measurement devices to allow monitoring of wort run-off rates and differential pressure across the bed of spent grains, and was capable of discriminating between two malts with quite similar specifications. Similar, although less complex designs were reported also by Huite and Westermann, (1974), Webster (1981), Armitt et al, (1984) and Laing and Taylor (1974).

ANALYSIS OF MALT MILL PERFORMANCE AND GRIST SIZE DISTRIBUTION

Efficient milling will give grist with a particle size distribution that will benefit rapid extraction, enzymic digestion, yield and throughput. To achieve maximum throughput yet adequate extract yield, requires a balance of fine grits to coarse grits. Briggs et al suggested that lauter tun efficiency can be enhanced by achieving a grist particle size distribution in the region of 15% husks, 23% coarse grits, 30% fine grits and 32% flour, while Kunze suggests that the grist should consist of 18% husk, 8% coarse grits, 56% fine grits and 18% flour. However it is a reasonable assumption that optimum grist size distribution is dependent on a brewery's specific requirements for quality of wort, extract yield and demands on throughput. A two roller professional malt mill (supplied by Wes Smith & associates PTY limited/Sydney) was assessed for reproducibility of grist particle size distribution at various roller gap settings. The desired profile is based on that used by a local brewery.

RESULTS OF MILLING ANALYSIS

The affect of gap setting between the rollers and grist particle size distribution can be seen in Figure 1 and the effect of duplicate runs through the mill at setting 0.55 mm observed in Figure 2.

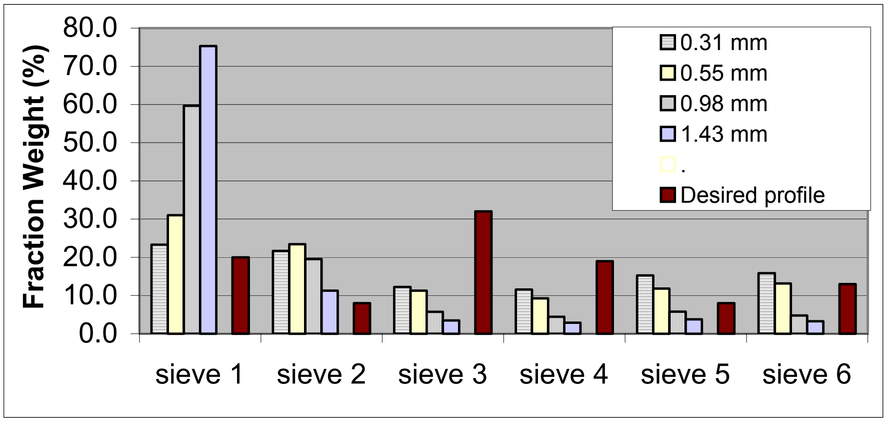

Figure 1. The effect of gap size, between the mill rollers, and grist particle size distribution. Sieving produces 6 fractions. Fraction 1 containing husk to fraction 6 containing fine flour.

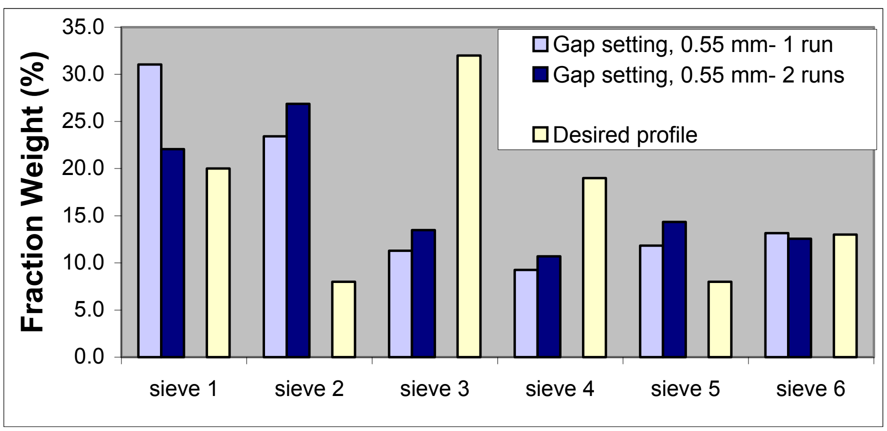

Figure 2. The effect of multiple runs through mill on grist particle size distribution at 0.55mm gap setting.

METHODS- OPERATION OF LAUTER TUN

- Malt was milled using a 2 roller professional malt mill. (supplied by Wes Smith & associates PTY limited/Sydney)
- Mashing (3:1), 64^0C / 40 mins, increment from 64^0C to 74^0C over 10 minutes, 74^0C / 10 mins
- Mash transfer to pre-heated SSLT (78^0C)
- Recirculate for 10 mins.
- Run-off at constant rate (50ml/min).
- Differential pressure and bed height recorded throughout
- At sparge level (total pressure of 0.78 psi) readjust pressure below bed to 0.32 psi by adjusting flow rate with peristaltic pump.
- Lautering was stopped when gravity dropped to below 1004.

The small-scale lauter tun designed for comparative analysis of malt performance. Inner glass tubing holds approximately 850g of grist. Wort flow-rate is regulated by a peristaltic pump (not shown), which also controls both recirculation and sparging. Performance of the grain bed is monitored by the differential pressure across the grain bed, measured by a water manometer and pressure transducers in conjunction with the volume collected throughout the lautering process. Each malt sample was mashed using a standard IoB infusion program. The mash was transferred to the lauter tun and recirculated for ten minutes prior to collection of wort. Wort was collected using a peristaltic pump at a set flow rate (45 ml/min) until the standardised sparging level was reached. Once sparging level was reached the flow rate was adjusted so as to reach a specified differential pressure, which was kept constant throughout the remaining process. Wort was collected for each ten minute interval during lautering until the gravity dropped below 1.004.

RESULTS OF LAUTERING

Initial investigations show good discrimination between malts with varying percentages of under-modified malt added, in terms of run off times and quantities collected Figure 3. Analysis of β-glucan content in samples collected during lautering, confirms the presence of higher glucan content with added under-modified malt (Figure 4). The effect of bioglucanase on glucan content can also be observed in Figure 4 and compared to the consequent effect on lautering performance Figure 5.

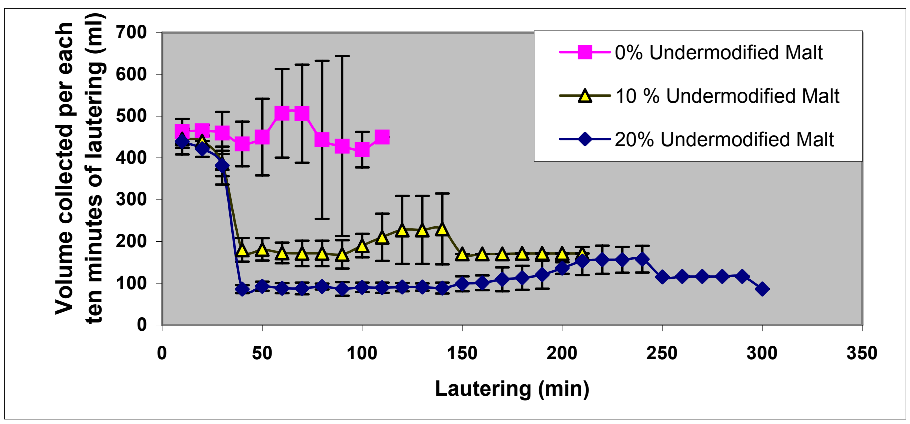

Figure 3. Comparison of wort volume collected between lauter tun runs with 0, 10 and 20 % added under-modified malt. Volume shown is that collected during each ten minutes of lautering. Runs were done in triplicate

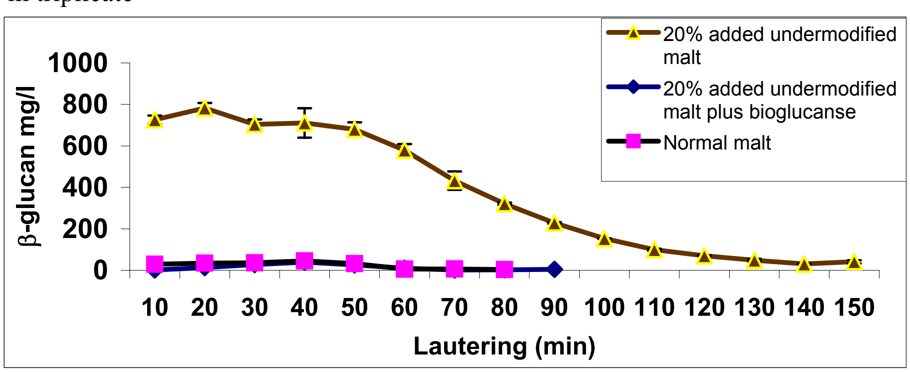

Figure 4. Effect of bioglucanase on the beta glucan content of 20 % added under-modified malt. The -glucan content can be compared to that of the normal malt lauter run and to that containing 20% under-modified malt with no added bioglucanase. Bioglucanase was added to a mash concentration of 1300 U/l. Samples were assayed in duplicate.

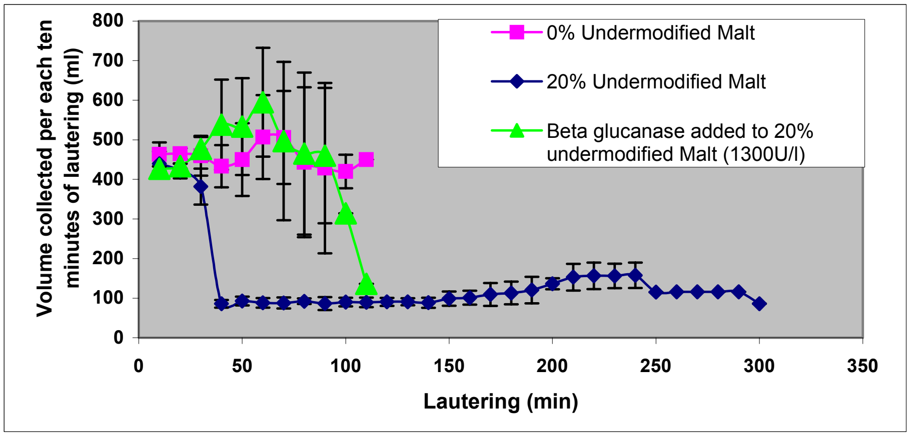

Figure 5. Effect of bioglucanase on the lauter run off time of malt mashes containing 20% added under-modified malt. The effect of reduced □-glucan content on run off times in the lauter tun can be seen when compared to the 20% added under-modified malt run without added bioglucanase.

CONCLUSION

Milling of malt was standardised using a roller gap setting set at 0.55 mm for two runs per sample. This was the closest attainable grist particle size distribution possible using the two roller mill, compared to that achieved by the more complex six roller mill used in industry.

Experimental lautering protocols have been developed that reflect those used in Australian breweries. Initial investigations show the SSLT system achieved good discrimination between malts with varying percentages of added under-modified malt. Analysis of β-glucan content of samples collected during lautering confirmed the presence of higher β-glucan content with added under-modified malt and further analysis demonstrated that β-glucan was the main contributing factor which caused decreased lautering efficiency. Further research is required to ascertain the influence of other malt components that play a role in poor lautering efficiency. Problems with malt quality in relation to lautering efficiency may lie in the inhomogeneity of malt modification as suggested by Palmer (2000). This inhomogeneity can cause brew house problems but cannot be detected with precision by standard malt analyses. Future analysis will address β-glucan size distribution in relation to lauter tun performance rather than total β-glucan alone.

ACKNOWLEDGMENTS

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