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THE MALTING OF TRITICALE

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The malting of triticale

by

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Final report of a project of three years and three months duration which commenced in October 1984. The work was supported with a grant of £16,736 to the Birmingham Malting and Brewing Group, Department of Biochemistry, University of Birmingham (Project No. 0005/1/86).

NOTE The full report of this project is the Ph.D. thesis by Andrea Jane Blanchflower entitled 'The Malting of Triticale' which is available through the inter-library loans system.

The Malting of Triticale

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Final report on a grant for three years which commenced in October 1984 and was extended for a further three months.

Background

Triticale can now be grown succesfully in the UK. At present the only certain market for the grain is for feed. The project evaluated the malting characteristics of triticale, with a view to using it in brewing.

A series of malting trials, using a range of triticale varieties, showed the grains can be malted successfully. A high yielding variety, Rosko, produced well modified malts with hot water extracts of 315 $1° kg^{-1}$ d.m. after 4-5 days germination. (Blanchflower and Briggs, 1985). A commercial pale ale barley malt would have a hot water extract of around 307 $1° kg^{-1}$ (Briggs, Hough, Stevens and Young, 1981). A comparative survey of 12 varieties produced a range of well modified malts. There were varietal differences in malt yields, hot water extracts and filtration times (Blanchflower and Briggs, 1986). The protracted filtration times of some malts were an undesirable characteristic which would create problems in the brewing filtration process. Furthermore the haziness of some worts was also undesirable. In direct contrast to barley malt the worts from well modified malts were hazy, whilst worts from under modified malts were clear. Factors affecting the filtration and viscosity of triticale malt worts were therefore investigated.

Methods

The hot water extract determinations allowed the measurement of wort collection times, wort viscosities and the extract yields.

The grist particle size distribution was determined using a set of mechanically shaken sieves. Oxidizing or reducing agents, or enzyme mixtures were added to wort samples. Wort viscosities were determined at 30°C.

Pentosan was precipitated from wort using ammonium sulphate (Preece and MacKenzie, 1952). Water-insoluble polysaccharides were extracted from mash residues using 4-methyl morpholine N-oxide, (MMNO), (Voragen, Schols, Marijs and Rombouts, 1987).

The ferulic and acetic acid contents of various fractions were determined by high pressure liquid chromatography (HPLC).

Results

The viscosities and collection times of various worts were measured. The viscosities were higher than those of comparable barley malt worts and, surprisingly, were relatively little effected by the degree of malt modification or the coarseness of the grist. However, differences in wort collection times were large. Unexpectedly, undermodified malts had smaller wort collection times (filtered more quickly) than better modified malts. All finely ground malts filtered very quickly as the grists did not form filter beds. These results constrast with the characteristics of barley malts.

The physical state of the grist influenced the filtration performance of triticale mashes. In coarse grists there were no large husk-type particles and the flour particles were very granular. The poor size distribution of particles was even more pronounced with a finely ground grist.

The wort constituents causing high wort viscosities were investigated by testing the effects of enzyme mixtures or oxidizing or reducing agents. A non-specific protease and mixtures containing α-amylase, β-glucanase and/or a protease were without effect, as were oxidizing and reducing agents. The protease, however, did clear the turbidity associated with worts from well modified malts, indicating the involvement of proteinaceous material in haze formation. Only a preparation containing xylanase, cellulase, hemicellulase and β-glucanase activities reduced wort viscosity. Thus the high viscosities were probably due to a non-starch polysaccharide, specifically a pentosan. This was confirmed when this enzyme mixture reduced the viscosity of a solution of a pentosan prepared from triticale wort.

The cell walls of cereals often contain ferulic and acetic acid residues. Ferulic acid residues esterified to cereal pentosans may form cross-linkages between molecules (Geissmann and Neukom, 1973). This, together with the acetylation of the polysaccharide, may reduce the solubility of the pentosan and may impede its enzymic degradation in malting and mashing (Fincher, 1976; Bacon, Gordon and Morris, 1975). The limited or non-degradation of pentosans during malting and mashing would result in the high viscosities of triticale worts and might influence filtration performance.

Both feruloyl- and acetyl-residues were measured in the pentosans of triticale worts and also in the water insoluble non-starch polysaccharides. The esterified ferulic and acetic acids were liberated by saponification and were quantified by HPLC. The pentosan of triticale malt contained 0.26% (w/w) feruloyl- and 0.22% (w/w) acetyl-residues respectively. The respective values in the water insoluble fractions were 0.33, 0.34 and 1.11% (w/w) and 0.67, 0.66 and 1.57% (w/w), for the MMNO extracted water soluble, water insoluble and MMNO insoluble fractions.

Conclusions

Well modified malts were prepared from triticale. They had high hot water extracts and were obtained in good yields. However, triticale worts were found to be turbid and highly viscous and mashes filtered poorly. The turbidity was due to proteinaceous material in the wort. High wort viscosity was due to the pentosan that was present. Unexpectedly, wort viscosity was not influenced by the degree of malt modification or the degree of milling. Filtration, however, was influenced by both of these factors. The presence of feruloyl- and acetyl-residues, esterified to soluble pentosans and the water insoluble polysaccharides, may have rendered these polysaccharides resistant to degradation during malting and mashing.

References

Bacon, J.S.D., Gordon, A.H. and Morris, E.J. (1975) Biochem. J., 149, 485-487.

Blanchflower, A.J. and Briggs, D.E. (1985) H-GCA Progress Reports on Research and Development.

Blanchflower, A.J. and Briggs, D.E. (1986) H-GCA Progress Reports on Research and Development.

Briggs, D.E., Hough, J.S., Stevens, R. and Young, T.W. (1987) Malting and Brewing Science. Volume 1, Malt and Sweet Wort. Chapman and Hall, London.

Fincher, G.B. (1976) J. Inst. Brew., 82, 347-349.

Geissman, T. and Neukom, H. (1973) Cereal Chem., 50, 414-416.

Institute of Brewing, Recommended Methods of Analysis. Journal of The Institute of Brewing March 1977, revised March 1982.

Preece, I.A. and MacKenzie, K.G. (1952) J. Inst. Brew., 58, 353-362.

Voragen, A.G.J., Schols, H.A., Marijs, J. and Rombouts, F.M. (1987) J. Inst. Brew., 93, 202-208.