BREWING OF ENGLISH STYLE ALES WITH MALTED CEREALS, OTHER THAN BARLEY

DAVID G. TAYLOR & PETER M. HUMPHREY - USHERS OF TROWBRIDGE PLC, U.K.,
JOHN BOXALL & PETER J. SMITH – SIMPSON'S MALT (BERWICK-ON-TWEED) U.K.

ABSTRACT

For several years, Ushers of Trowbridge have been brewing a range of Traditional English Ales (called the 'Four Seasons Ales'), in both classical cask-conditioned, fined draught form and in bottle, using malted oats, malted wheat and malted rye as grist ingredients, in addition to conventional malted barley. The production of these malted cereals was carried out in conjunction with J.P. Simpson & CO (Alnwick) Ltd. in their Tweed Valley Maltings in Berwick-upon-Tweed; these malts are now all commercially available in the U.K. Considerations of the malting characteristics of the varieties of the cereals chosen are presented, with details of the production procedures involved. The flavour contributions of these cereals can be significant at relatively low proportions in the grist, and provide several opportunities in the development of new taste characteristics that are still consistent with the expected flavour and presentation of traditional English ales. Some details of brewhouse performance and processing considerations, such as fining and filtration characteristics, are also presented.

INTRODUCTION

For several years, as part of their portfolio of regional beers brewed in the South West of England, Ushers of Trowbridge has been brewing a range of Traditional English Ales, in both classical cask-conditioned, fined draught form (i.e. not filtered, not pasteurised, and containing live yeast) and chilled/filtered

in bottle, using malted cereals other than barley in the grist compositions. Alternative cereals are, of course, used very successfully as adjuncts in many beers. Indeed, several beer brands use rice and maize as grits, but cereal cookers are required; very few U.K. brewing operations have cereal cooking facilities. Further, unmalted sorghum and barley itself can be satisfactorily used, but usually require substantial additions of enzymes (of fungal and/or bacterial origin) during mashing, with protracted mashing programmes, involving several graduated temperature changes. There are numerous instances in which other cereals have been used in unmalted forms in specialist applications, for example as flours or as pre-gelatinised flaked products in a number of beers, such as, Oatmeal Stouts. Wheat flour (also in compressed pellet form) has been applied to enhance head retention in several beer types.

However, using unmalted cereals as grist adjuncts can present certain challenges, such as milling problems (especially with wet or steep-conditioning mills) and undesirable flavours may arise from the 'cooking' conditions occurring during the flaking process.

By using malted cereals, you avoid many of the potentially negative features and allow higher grist proportions to be used without the need to consider the use of additional mashing enzymes. In addition, there is a certain element of provenance associated with malted cereals, which can be especially important in marketing considerations for beers such as traditional English cask ales.

For these reasons, we have brewed with malted oats, malted wheat and malted rye as part of our Seasonal Beers strategy ('Four Seasons Ales'). There has been a close association between Ushers and Simpson's Malt for many years and a number of pilot-scale brewing trials have previously been carried out, using a range of malted cereal varieties produced by Simpson's Malt. As a consequence of this collaboration, a wide range of speciality malts are now commercially available.

SELECTION CRITERIA

The selection of the cereals to be used in the range of beers to be produced on a seasonal basis was more related to marketing strategy than any considerations of seasonal availability or harvesting. Consequently, wheat was chosen for the summer beer because of the established tradition of producing light, refreshing beers brewed with wheat in the summer. Rye has a classical autumnal connotation, whereas oats have an obvious, albeit frivolous, association with springtime. More importantly, it had already been established through the joint pilot studies that Simpson's could readily produce malts from these cereals and had identified suitable varieties that were readily available, as follows:

- Oats - the winter variety – 'Imagen' (also selected because of its larger grain size),
- Wheat - the winter variety – 'Riband' (a soft wheat, known to malt satisfactorily for brewing, as well as used for bread making),
- Rye - the winter variety – 'Halo'

MALTING CHARACTERISTICS

An indication of the main compositional features of these cereals in comparison with malting barley (U.K. 2-row) is presented in Table l. The importance of these features on the characteristics of the malts produced is detailed below.

Table 1 - Average Compositions (% by weight)

	BARLEY	OATS	WHEAT	RYE
SOLUBLE CARBOHYDRATE	78	70	79	80
PROTEIN	12	11.5	14	13.5
LIPID	2	5	2.5	2
FIBRE	5	10.5	2.5	2
MINERAL	3	3	2	2.5

Oats

The relatively low carbohydrate content is reflected in low potential extract and the high fibre content is a consequence of the high husk fraction (and small endosperm). The total nitrogen level is similar to barley (U.K. 2-row), but it is found that only some 10% remains permanently soluble. Further, oats have a high lipid content. The grain size is slightly longer than barley, but considerably narrower (approx. 1/2 the diameter).

Wheat

Wheat has a loose husk which is not retained during malting and leads to rapid moisture uptake. The protein contents tend to be significantly higher than barley and, as a rule, modification and friability are poorer with lower levels of free amino-nitrogen, although enzyme levels (especially amylolytic activities) tend to be higher with enhanced extracts. The grain size is approximately the same as barley, but rounder.

HALTING PROCEDURES

Some of the key features employed in the malting procedures are detailed below. ➜

Oats

A single water steeping schedule is all that is required to achieve sufficient moisture content (in excess of 42%), due to the thin nature of the grain. A staged germination temperature programme from 14°C to 18°C is used to ensure even germination control. The green malt is turned every 8 to 12 hours to achieve even acrospire growth. The kilning temperature profile ramps from 50°C up to 80°C maximum.

Wheat

Two short steep water periods are used to attain the target moisture of greater than 42%. Additional water may be sprayed after 24 hours germination to maintain moisture at over 42%. To ensure even germination, staged process temperatures are set at 12°C to 18°C.
The green malt is turned gently (to avoid damage to the exposed acrospire, due to lack of husk) every 6 to 8 hours. The kilning temperature profile ramps from 50°C up to 85°C.

Rye

A single short water steep is used to attain greater than 41% moisture (water absorption is rapid, due to the lack of husk and small grain size). It is important to avoid oversleeping and to discharge the steep vessel rapidly after draining to prevent grain bridging. Similarly, it is important to avoid bed compaction during germination and kilning.
Germination process temperatures start at 17°C rising to 22°C and the green malt is turned very gently (exposed acrospire) and frequently (every 4 to 6 hours).
The kiln temperature profile ramps up to a maximum of 75°C, to avoid excessive colour development.

BREWHOUSE PERFORMANCE

The key malt analyses are presented in Table 2 in comparison with the standard analysis achieved for Pale Ale Malt (using

U.K. 2-row barley, typically the winter variety - 'Halcyon'). The relevance of these analytical parameters on brewhouse performance is detailed below.

Table 2 - Typical Malt Analysis

	BARLEY	OATS	WHEAT	RYE
DRY EXTRACT (LDK)	307	234	325	316
MOISTURE (%)	3.5	3.0	5.0	4.4
COLOUR (IoB)	4.5	2.5	3.0	7.5
TN (%)	1.55	1.60	1.87	1.65
TSN (%)	0.6	0.3	0.7	0.7
SNR	39	18	38	42
DP (IoB)	55	67	80	56

Oats

The most noticeable feature is the relatively low extract recovery; indeed, initially this was especially low in practice because it was not appreciated that the mill gap setting (on the steep conditioning mill used) had to be reset to only 0.2 mm in order to achieve a satisfactory grind of the very thin oat grain. As a consequence, in initial brews the Lauter runoff rate was considerably increased, when it was anticipated that the high husk content should actually improve mash runoff rates. It was found that the only partially ground oat grains were not achieving full starch breakdown and thus caused considerable increase in wort viscosity.
Milling performance had to be compromised between grinding oats sufficiently, but not grinding the malted barley fraction too finely; it was not practical in our brewhouse to mill the two grain types separately.

Another feature of the malt analysis is the very low level of nitrogen modification, leading to low malt soluble nitrogen (TSN) and low soluble nitrogen to total nitrogen ratio (SNR). After boiling, the soluble nitrogen content (i.e. permanently soluble nitrogen, PSN) drops by a further 50%, so that only some 10% of the original grain Tot l Nitrogen (TN) remains soluble in wort.
This potential dilution of wort soluble nitrogen (and potentially free amino-nitrogen) did not cause any fermentation concerns with the ale yeast strain used, but this may be a factor to be considered in determining the proportion of malted oats in grist compositions.

Wheat

In contrast to oats, malted wheat has no husk and can lead to poor mash filtration at high grist levels (> 30%). However, controlled slow speed raking can achieve adequate Lauter performance, although wort clarity may be slightly compromised. Poorer wort clarity may also be influenced by the higher protein (soluble nitrogen) content.

Very high extract recoveries can be obtained from malted wheat and the high enzyme levels, as indicated by Diastatic Power (DP), may also enhance the extract recovery obtained from the malted barley portion of the grist.

Rye

Like wheat, malted rye has no husk and the impact on wort runoff rates can be even more apparent, since the soluble nitrogen content is similarly higher than barley. In addition, wort viscosity is also increased, probably from a higher B-glucan and/or pentosan content in rye.

The smaller, and somewhat variable, grain size may also dictate the adjunct level attainable. However, grist proportions at up to 30% are achievable without too much impact on brewing cycle times.

Extract recovery from rye is also slightly enhanced over barley. One interesting feature of worts derived from malted rye is the very red hue of the wort colour. Indeed, restricting colour development during kilning is an important malting control parameter.

EFFECTS ON BEER FLAVOUR

The flavour contributions from these different cereals can be significant, even at relatively low grist proportions. A review of the taste characteristics is presented below.

Oats

A key flavour attribute provided by malted oats is a pronounced toasted, biscuity aroma and palate, combined with a creamy and relatively intense mouthfeel.

These flavour effects can be apparent at less than 10% replacement of barley in the grist, depending on the overall strength of flavour.

These flavour attributes blend especially successfully with straw yellow coloured beers.

Wheat

Even at high grist levels (up to 50%), malted wheat has the most neutral flavour effects of the cereals considered. Overall, there is little influence on aroma, but a creamy, soft palate effect can be obtained. At slightly higher grist levels (>20%), a crisp dry citrus and tangy afterpalate is apparent, which has a distinctly refreshing, mouth cleaning effect.

These flavour characteristics are most noticeable in pale, light flavoured products and the effects blend well with warm, golden coloured beers.

Rye

Malted rye has the most intense flavour effects of all these cereals. Even at low levels (<10%), one can detect an obvious toffee/caramel character on aroma and palate, with a pronounced smooth mellow mouthfeel. At higher levels (>15%), a distinctive minty/juicy palate and afterpalate are apparent.

These flavour effects combine well with darker malt flavours, such as crystal malts, and the rich ruby red colours attainable with rye can be successfully augmented with dark malt colours.

INFLUENCES ON PROCESSING CHARACTERISTICS

HEAD RETENTION

One key beer analytical parameter influenced by these different cereals is Head Retention Value (HRV), as indicated in Table 3. The results presented were obtained by the NIBEM method of analysis and refer to beers of approximately equivalent composition in terms of extract levels derived from the other cereals (20%), with other analytical parameters as indicated.

It is apparent that malted wheat significantly enhances head forming ability, with malted rye to a lesser extent. This effect is almost certainly a consequence of the higher protein content and is in confirmation of previous experience of the beneficial contribution of wheat to beer head retention.

Table 3 - Influence on Head Retention – NIBEM Method

HRV:	- MALTED BARLEY (100%)	:	250 SECS
	- OAT BEER	:	245 SECS
	- WHEAT BEER	:	300 SECS
	- RYE BEER	:	265 SECS

Oats

The slightly reduced HRV seen in Oat beer is almost certainly related to the lower soluble nitrogen content present and is probably not related to the high lipid content of the oats (the major portion of which is probably retained in the spent grains after lautering). This point is further supported by the observation that there is no reduction in flavour stability detected in

oat beer, in comparison with equivalent products (up to 12 months storage in bottle).

Wheat

Two processing features of wheat beer noted are as follows:

- in the cask conditioned beer, it was found that fining performance was somewhat poorer and that a higher addition rate of silicate auxiliary finings was required (i.e. additional protein precipitant was needed).
- there was a potential for reduced haze stability in the chilled/filtered wheat beers, which necessitated a higher degree of chill-proofing treatment.

Rye

The rye beers had good fining ability in cask conditioned form, but poorer filtration performance was noted in the chilled/filtered beer, due to increased viscosity. However, excellent haze and flavour stabilities were obtained.

CONCLUSIONS

The original objective of evaluating the possible development of new flavours in traditional English style ales by the use of other malted cereals has been achieved and indeed several new product opportunities have arisen and more can still be envisaged.

However, it is perfectly clear that we are actually guilty of reinventing the wheel, since we have merely re-learnt how to malt and brew with ingredients used by our forebears.
Nevertheless, the flavour characteristics offered by using extract materials other than barley, either individually or blended or even mixed with more aromatic flavourants, such as honey, ginger, orange zest or coriander, means that there is virtually no limit to the range of new taste experiences available.
Even just within the realm of alternative malted cereals, there are a number of flavour and beer presentation opportunities to be realised. For the future, many options can be explored and already maltsters are making an ever increasing range of speciality malts. Certainly, the cereals studied here are also available as aromatic malted variants and as various coloured malts, such as Crystals, Ambers, Browns, etc.
There is now no excuse for not providing an ever more experimental drinking public with the chances to sample a wider range of taste experiences, but still legitimately defined as beer.

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to the Directors of Ushers of Trowbridge plc and of J.P. Simpson & CO (Alnwick) Ltd. for their permission to publish this paper.