MICROMALTING TRITICALE

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Received 22 December 1983

A sample of 'Lasko' triticale, a wheat x rye hybrid cereal, was micro-malted in a variety of ways. The grain was adequately steeped in under 24 h, and was relatively unaffected by high steeping temperatures, or the use of air-rests. Malts with exceptionally high extracts (about 340 1°/kg dry) and diastatic powers were obtained with malting losses of about 8% after 4 days germination. However, levels of soluble nitrogen were also high, even when potassium bromate had been employed. Malts made from this cereal could be of value in mixed brewing grists and in the manufacture of some malt extracts.

Key words: *malting, triticale.*

Introduction

In several areas of the world newer varieties of triticale (*Syn. Triticosecale*; wheat (*Triticum*) x rye (*Secale*) hybrids) are being grown commercially. Under many circumstances they yield more grain (weight per unit field area) than wheat. Triticales are being evaluated in the UK and one hexaploid variety, Lasko, which originates from Poland,[10] has yielded so well,[4,6] that probably it will soon be grown commercially. Triticales are likely to be grown for animal feed because the grains are characteristically rich in nitrogen. The tendency for triticale grain to pregerminate reduces its value for millers, but suggested to us that it might be easy to malt. It seemed appropriate to evaluate a triticale that is agronomically acceptable in the UK using micromalting trials. The results obtained, using a single nitrogen-rich sample of Lasko (that was not selected for potential malting use), were sufficiently promising to merit this short description.

Materials and methods

Clean and plump triticale grain (*cv.* Lasko) was kindly given by D. M. Miles of the Guinness Barley Research Station. The grain was supplied as having a specific weight of 72 kg/hl, and a Hagberg falling number of 62. Samples of grain (75 g, fresh weight), held in Duran bottles, were micro-malted in humid conditions in constant temperature cabinets. Additives were applied in solutions sprayed on after steeping. Samples were dried in a rapid air flow at 43°C.

Analyses were usually made according to the Recommended Methods of the Institute of Brewing, or micro-modifications of them, unless indicated otherwise. Each hot water extract is expressed on a dry matter basis. The sanded block, methylene blue method for investigating modification was carried out according to Greif[5] and van Eerde.[3] Pericarp content was estimated using decortication with 50% sulphuric acid.[7]

Moisture contents, 'internal moistures' attained during steeping, were determined after a 1 h drain period, or on centrifuged grains. We routinely use this second technique for barley, but it was not very accurate with triticale because the lack of husk allowed some grain to be damaged. An additional film of surface moisture always remained on the steeped grains after these had been drained.

Results

The triticale grain was partly characterised, with the following results: moisture, 16·3 (%); total nitrogen, 2·52 (%; standard deviation 0·08, $n = 15$); germinative capacity 98 (%; hydrogen peroxide test); germinative energy 91 (%; 4 ml test), 77 (%; 8 ml test); thousand corn weight, 40·6 (g, dry matter); sieving test, (%; by weight) 82·6 on 2·78 mm screen, 12·4 on 2·5 mm screen, 3·1 on 2·1 mm screen, 1·7 thin grains.

In preliminary experiments grain was steeped, without changing the liquor, at 15 or 25°C and had drained moisture contents, after 24 and 17 h immersion, of about 40 and 43% respectively. Hot water extracts were maximal, after 5 days germination at 15°C, at 340 and 337 (1°/kg) respectively, in yields of 88·3 and 89·3 (%, d.m.). Maximal extracts on original grains (i.e. HWE x malt yield) were obtained in 4 days germination. The acrospires grew away from the grains and so were later collected in the 'rootlet' fraction. Growth of the rootlets themselves was not particularly vigorous. The high extracts and similar performances in the grain samples that had been steeped at different temperatures conflicted with expectations based on experiences with barleys, so more trials were undertaken. Grain samples were again steeped at two temperatures for various periods and were germinated at 15°C. Samples were taken daily for analysis. Hot water extracts were still increasing when the experiment was terminated, after 4 days germination (Table I). Clearly the malt analyses are influenced by the initial moisture contents, but very little by the steeping temperature. Steeping for shorter times gave malts in better yields, and with less rootlet production, but with marginally reduced extracts. In terms of extract yield on raw grain (HWE x malt yield) samples steeped for the shorter times were clearly the best (Table I).

The effects of air-rest steeping at two temperatures and applications of gibberellic acid on malting triticale were evaluated. Analyses were performed on germinating samples taken daily for up to 4 days. In each group of samples the best extracts were obtained on the fourth day. The results (Table II) confirm the tolerance of triticale to steeping at

TABLE I. Analyses of Triticale Malts, *cv.* Lasko, Prepared by Steeping as Indicated, without Changes of Steep Liquor, and Germinating for 4 days at 15°C*

Steep temperature (°C)	15	15	15	25	25
Steep duration (h)	15	40	48	10	24
Internal moisture (% fresh weight)	36·8	42·4	43·8	37·5	43·0
HWE (1°/kg, 0·2 mm)	335(4)	336(3)	338(4)	334	336
Malting loss (%)	7·9	10·2	10·9	8·5	9·8
Rootlets + acrospires (%)	1·9	2·1	2·3	1·6	1·7
HWE (1°/kg) x Malt yield (%)	309	302	301	306	303

*Results are the means of duplicates, except where indicated by numbers in parentheses.

TABLE II. Analyses of Triticale (*cv.* Lasko) Malts Prepared by Steeping with or without Air-rests, at Two Different Temperatures, and Germinated for 4 days at 15°C. Samples were Sprayed with Water or Gibberellic Acid Solutions at Steep-out*

Steep temperature (°C)	15		15		25		25	
Steep duration (h)	24		24		17		17	
Air-rest† (h)	0		5		0		4	
Gibberellic acid (mg/kg)	0	0·25	0	0·25	0	0·25	0	0·25
HWE (l°/kg, 0·2 mm)	331	342	327	339	328	344	326	340
TSN (%)	1·01	1·47	0·88	1·43	0·92	1·53	0·88	1·48
Malting loss (%)	7·5	7·7	6·8	8·4	6·6	8·5	8·3	7·6
Rootlets+acrospires (%)	1·9	1·8	1·4	1·6	1·6	1·4	1·4	1·1
HWE (l°/kg)×Malt yield (%)	306	316	305	311	307	315	299	314

*Results are the means of duplicates.
†At 15°C the air-rest steeping schedule was: 15 h wet, 5 h dry, 4 h wet.
At 25°C the air-rest steeping schedule was: 10 h wet, 4 h dry, 3 h wet. For the 'no air-rest' steeps liquor was changed once, after 15 h at 15°C, and after 10 h in the 25°C steep.

25°C. Surprisingly there was no advantage to including an air-rest in the steeping schedule. However, an application of gibberellic acid substantially increased the hot water extract. Unfortunately the quantities of soluble nitrogen, which were already high, were further increased by gibberellic acid (Table II). The extent of modification in each grain sample was assessed using the sanded block/methylene blue technique. The results were not as clear as are usually obtained with barley, but modification progressively extended from the embryo ends of grains with malting time and was most extensive in grains treated with gibberellic acid and germinated for 4 days.

Potassium bromate was tested for its ability to reduce soluble nitrogen levels. Once again the results obtained after four days germination were the most interesting (Table III). Used in combination with gibberellic acid bromate did reduce soluble nitrogen to a significant extent (from 1·39 to 1·25%) without greatly reducing the hot water extract, but the reduction of malting losses, from 9·0 to 7·5 (%) was more striking.

TABLE III. Triticale (*cv.* Lasko) Malts Germinated for 4 days at 15°C, Made with and without Applications of Gibberellic Acid and Potassium Bromate. All Samples were Steeped for 24 h at 15°C, with One Change of Water after 15 h*

Gibberellic acid (mg/kg)	0	0·25	0	0·25
Potassium bromate (mg/kg)	0	0	100	100
HWE (l°/kg, 0·2 mm)	339(4)	346(4)	333(4)	343(4)
TSN (%)	1·05	1·39	1·02	1·25
Malting losses (%)	8·7	9·0	6·9	7·5
Rootlets+acrospires (%)	1·5	1·7	1·0	1·2
HWE (l°/kg)×Malt yield (%)	309	315	310	317

*Results are means of duplicates, except where indicated by numbers in parentheses.

To evaluate triticale malts in statistically significant terms, a large number of replicates of two types of malt were prepared. Both were treated with gibberellic acid and one with potassium bromate (Table IV). Clearly, well modified triticale malts can easily be prepared in acceptable yields and can have outstandingly good extracts, and high diastatic powers. The coarse-fine extract differences are acceptable. However, levels of soluble nitrogen are high. Wort viscosity and colour are a little high relative to the values for pale barley malts made in comparable ways.

Discussion

The tolerance to different steeping conditions, the requirement for only short steeps, and the ability to yield malts with outstandingly high hot water extracts in 4 days germination, with acceptable malting losses, all make triticale an attractive grain to malt. On the other hand the absence of husk might give handling problems during malting (as are encountered with wheat and rye), and could give rise to filtration problems during lautering of an 'all triticale' malt mash. In addition the high level of soluble nitrogen would be disadvantageous to traditional brewers. However, the inclusion of an unmalted adjunct with triticale malt in a grist which also contained barley malt would 'dilute' the soluble nitrogen, and take advantage of the exceptional diastatic power of the triticale malt. These results are consistent with the results of various reports of trials with North American materials.[2,8,9] The American workers demonstrated that, especially in mixed grists, triticale malts were acceptable for use in beer production.

TABLE IV. Analyses of Replicated Preparations of Triticale (*cv.* Lasko) Malts. Each Set contained 32 Replicates. These were Analysed Individually or after Combining in Pairs, as Indicated.* Grains were Steeped for 24 h, at 15°C, with a Change of Steep Liquor after 15 h. At Steep-out Samples were Sprayed with Solutions of Gibberellic Acid with or without Potassium Bromate. Germination was for 3 days, 18 h at 15°C

Gibberellic acid (mg/kg)	0·25	0·25
Potassium bromate (mg/kg)		100
HWE (l°/kg, 0·2)*†	344·4±0·8 (16)	341·8±1·4 (16)
HWE (l°/kg, 0·7)*†	341·8±1·0 (16)	339·1±1·3 (16)
Fine-coarse extract difference (l°/kg)	2·7	2·7
Malt yield (%)*	91·4±0·8 (32)	92·9±0·4 (32)
Rootlets+acrospires (%)*	1·7±0·2 (32)	1·4±0·1 (32)
TSN (%)*	1·39±0·02 (16)	1·24±0·02 (16)
TN (%)*	2·47±0·01 (16)	2·47±0·01 (16)
TSN/TN	0·56	0·50
Wort viscosity (cP)	1·82	1·82
Colour (°EBC)	3·5	3·5
pH (EBC)	5·9	5·9
Diastatic power (°Lintner, ASBC)	199	198

*Results are given as mean±standard deviation (number of samples analysed).
†0·2, 0·7; gap settings on the Buhler-Miag Mill.

An interesting question is how it is that triticale malt grains (pericarp 5·7% having allowed for malting losses) have 'space' for potential extractives yielding 344 l°/kg when top quality barley malts with lower nitrogen contents (Husk + pericarp = 11% approx. again with allowance for malting losses) yield only 308 l°/kg? The question remains even if one considers the theoretical extract yield of notional pericarp-free triticale malt (344 ÷ 0·943 = 365 l°/kg) compared to notional husk *and* pericarp-free barley malt (308 ÷ 0·890 = 346 l°/kg). The difference, 19 l°/kg, or about 5·5% of the barley malt extract, suggests the presence of a relatively larger starchy endosperm in the 'decorticated' triticale. The three-cell thick aleurone layer of barley, with the hyaline layer, makes up about 10% of barley grains.[1] The aleurone layer of triticale is only one cell thick.[8] Possibly this lesser amount of aleurone is accompanied by a larger proportion of starchy endosperm in triticale, relative to barley (assuming equal-sized embryos). If correct this could account for the larger extract yields obtained from triticale malts.

The results obtained in these trials strongly suggest that malted triticale could find a place in brewing grists and the grists of malt extract manufacturers.

Acknowledgement.—We thank David M. Miles of the Guinness Barley Research Station, Codford, nr. Warminster, Wiltshire, for the generous gift of triticale grain.

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