

## DETERMINATION OF REPEATABILITY AND REPRODUCIBILITY OF EBC ACCEPTED METHODS IV—COLOURED MALTS

SUBMITTED ON BEHALF OF THE EBC ANALYSIS COMMITTEE BY M. BENARD

**Methods for the determination of caramel and roasted malt moisture, extract and colour published in Analytica EBC have been collaboratively tested by the European Brewery Convention Analysis Committee, according to the ISO standard 5725. Repeatability ( $r_{95}$ ) and reproducibility ( $R_{95}$ ) values are presented.**

**Key Words:** Collaborative test, analysis methods, caramel and roasted malts, precision.

### INTRODUCTION

The general procedure followed was the same as for malt and laboratory wort described in a previous paper<sup>1</sup> where definitions and an example are given.

### PROCEDURE

Five malt samples with colours ranging from 25 to 1600 EBC units were sent to 12 laboratories, including 9 Analysis Committee members and 3 malting plant laboratories which produce and analyse caramel and roasted malts.

Samples were obtained from 3 different maltsters.

A Pilsen malt for use as the enzyme source as recommended in the EBC method 5.2 was also sent out.

### RESULTS AND COMMENTS

Results are given in Tables I.1 to I.5 and summarised in Table II.

#### Moisture

Moisture was measured according to the EBC method 4.1. It was judged that there was no relationship between precision and the measured value. It was noted that  $r_{95}$  and  $R_{95}$  obtained in this test are half of the corresponding values found for pale malts in a previous test with the same range of values and results from 17 to 26 laboratories.

#### Extract

Extract was determined according to the EBC method 5.2. There was no relationship between precision and the measured value.

#### Colour (comparator)

Colour was measured according to the EBC method 5.2. The test report was organised in such a way that it was possible to verify that the measurement were carried out according to the conditions stipulated in the method, i.e. using the 20–27 EBC units disc.

A linear relationship between precision and the colour measured was clearly observed.

#### Colour (spectrophotometer)

The results of this trial revealed two problems:

- (i) membrane filtration did not always produce 'clear' worts, that is having an absorbance value at 700 nm low than 0.02.
- (ii) the ratio between spectrophotometric and comparator measurements was not constant, with values between 0.88 to 1.23 for the different malts.

For these reasons the method was not accepted by the Analysis Committee, and it was agreed that further work was necessary.

TABLE I.1. Moisture

Malt	Number of results	Mean	$r_{95}$	$R_{95}$
A	11	4.31	0.114	0.415
B	10	7.73	0.074*	0.438
C	11	4.08	0.075	0.254
D	10	4.75	0.037	0.191*
E	10	5.46	0.044*	0.321

\*1 outlier.

TABLE I.2. Extract % as is

Malt	Number of results	Mean	$r_{95}$	$R_{95}$
A	11	78.09	0.859	1.378
B	10	70.38	0.688*	1.724
C	10	73.10	0.554*	0.820
D	11	71.91	0.934	1.141
E	11	63.97	1.442	2.111

\*1 outlier.

TABLE I.3. Extract % d.m.

Malt	Number of results	Mean	$r_{95}$	$R_{95}$
A	11	81.60	0.900	1.330
B	10	76.30	0.750*	1.787
C	10	76.21	0.583*	0.824
D	11	75.47	0.980	1.244
E	11	67.66	1.527	2.209

\*1 outlier.

TABLE I.4. Colour (comparator), EBC units

Malt	Number of results	Mean	$r_{95}$	$R_{95}$
A	9	26.3	1.64*	6.34
B	10	53.8	1.66	13.49
C	10	132.5	6.07	32.08
D	10	675.6	25.15	224.57
E	10	1565.0	77.70	329.80

\*1 outlier.

TABLE I.5. Colour (photometer), EBC units

Malt	Number of results	Mean	$r_{95}$	$R_{95}$
A	11	27.0	2.20	5.33
B	11	60.9	2.49	8.77
C	11	141.6	9.63	40.88
D	11	547.8	32.88	151.37
E	9	1295.6	36.15*	96.69*

\*1 outlier.

TABLE II. Precision of caramel and roasted malt analysis methods (5 levels)

EBC method	Range	Number of laboratories	$r_{95}$	$R_{95}$
5.2 (=4,1) Moisture %	4.1-7.7	10-11	0.07	0.32
5.2 Extract, % as is	64-78	10-11	0.9	1.5
5.2 Extract, % d.m.	68-82	10-11	1.0	1.5
5.2 Colour (comparator)	26-1600	9-10	$r=0.045$ m	$R=0.255$ m

#### REFERENCE

1. Benard, M. *Journal of the Institute of Brewing*, 1992, 98, 81.