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Determination of boiled wort colour

Submitted on behalf of the Analysis Committee of the European Brewery Convention

A method for the determination of boiled wort colour has been collaboratively tested by the Analysis Committee of the European Brewery Convention. In this trial the 14th EBC Standard Malt and two commercial malts were tested by 21 laboratories. Repeatability (r_{95}) and reproducibility (R_{95}) values of 0.33 – 0.42 and 1.12 – 1.44 EBC units were obtained respectively at a mean level of 4.7 – 5.2 EBC units. At a mean level of 8.9 EBC units these respective values were 0.44 and 2.25 EBC units. The data sets could be split into two sub-sets for laboratories using either the included heating plate boiling procedure or the glycerol/oil bath boiling procedure. Statistical analysis of both sub-sets revealed that reproducibility is unambiguously better for the glycerol/oil bath procedure at all levels. For repeatability the situation is less clear. The evaluated method is recommended for inclusion in Analytica-EBC.

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Descriptors: Boiled wort colour, collaborative test.

Descriptoren: Kochfarbe, Ringanalyse).

1 Introduction

The Analysis Committee of the European Brewery Convention decided to evaluate a method for the determination of boiled wort colour. The method was a synthesis of two other methods which were different in the boiling procedure applied, viz. using a heating plate and glycerol/oil bath procedure. Both boiling procedures were hosted in the method tested here. A collaborative trial was organised in which originally 21 laboratories participated.

2 Experimental

The organisation of the collaborative trial and the statistical treatment of the data were carried out according to the procedures given in the International Standard ISO 5725 (1). The trial employed a balanced uniform-level experiment. Two industrial malts (A and B) and the 14th EBC Standard Malt (C) were distributed to the participating laboratories together with the method description. Soluble nitrogen contents for malts A – C were 0.80, 0.83 and 0.72 % d.m. respectively (2). Corresponding malt colours were 2.6, 4.8 and 2.6 EBC units respectively (3). Participants were requested to analyse the samples and to specify the boiling procedure(s) they had used.

3 Results and discussion

Results were received from 21 laboratories. The raw data are presented in Table 1. Two laboratories (9 and 10) employed a heating mantle for boiling and, therefore, their data were excluded from statistical processing. Laboratory 1 sent only one result for malt C and equally this result was eliminated. An incorrect sample of malt C was sent to laboratory 7. Therefore, the corresponding results were excluded. One laboratory employed both boiling procedures (lab 5 = lab 15). Stragglers according to the Cochran test were identified for two data sets of malt A and one data set of malt C. One Grubbs outlier was removed for both malt B and C.

Table 1 Raw data as obtained for the boiled wort colour determination (EBC units)

Laboratory	Malt A		Malt B		Malt C	
1	5.30	5.35	9.85	10.15	5.30	–
2	3.70	3.80	7.00	7.20	4.40	4.60
3	4.80	5.00	9.60	9.20	5.10	5.40
4	4.90	5.00	9.80	9.50	5.30	5.60
5	4.74	4.75	9.16	9.17	5.36	5.37
6	4.03	4.23	8.30	8.28	4.55	4.63
7	3.70	3.60	7.92	8.00	3.62	3.75
8	4.80	4.84	9.57	9.66	5.19	5.21
9	5.00	5.10	9.55	8.80	6.00	5.15
10	3.68	3.90	8.18	7.63	4.33	5.13
11	4.48	4.30	7.90	7.78	5.13	5.20
12	5.34	5.35	8.80	9.06	8.16*	7.94*
13	5.80†	5.15†	8.52*	9.54*	5.40	5.29
14	4.83†	4.35†	8.85	8.55	5.48	5.28
15	4.74	4.75	9.22	9.24	5.48	5.50
16	4.62	4.75	9.27	8.90	5.28	5.00
17	4.60	4.78	8.78	8.95	5.30	5.25
18	4.88	4.95	9.12	9.32	5.18	5.25
19	4.68	4.70	9.15	9.33	5.65	5.40
20	5.38	5.48	9.95	10.15	5.93	5.98
21	4.65	4.85	7.90	7.63	4.50	4.68
22	4.23	4.18	8.40	8.43	4.68	4.65

Boiling procedure: laboratories 1 – 8 heating plate; laboratories 9 and 10 heating mantle (data not used); laboratories 11 – 22 glycerol/oil bath.

† Straggler according to Cochran.

* Oulier according to Grubbs (eliminated).

Table 2 Summary of precision data (EBC units)

Malt sample	Boiling procedure	Number of laboratories	Mean	r_{95}	R_{95}
A	both	20	4.7	0.42	1.44
	glycerol/oil bath	12	4.8	0.51	1.18
	heating plate	8	4.5	0.24	1.72
B	both	19	8.9	0.44	2.25
	glycerol/oil bath	11	8.9	0.43	1.87
	heating plate	8	8.9	0.44	2.84
C	both	17	5.2	0.33	1.12
	glycerol/oil bath	11	5.3	0.29	1.09
	heating plate	6	5.1	0.39	1.18

The precision data are given in Table 2. The mean values for malts A and C are on the same level, whereas malt B yields a substantially higher mean value. The ratios between boiled wort colour data and malt colour data are 1.8, 1.9 and 2.0 for malts A – C respectively. This is in correspondence with usual ratio values based on extensive practical experiences with this method for pale malt worts. Repeatability data for the heating plate boiling procedure in comparison to those for the glycerol/oil bath procedure are better for malt A, but comparable or worse with both other malts. Reproducibility data for the glycerol/oil bath procedure, however, are better with all malts tested. In general, the repeatability data are substantially better than those obtained for malt colour for both the whole data set and the two sub-sets analysed separately. For reproducibility these values are higher but still in line with the corresponding malt colour data (4). Again, reproducibility data for malts A – C using the glycerol/oil bath procedure meet those for malt colour the best, giving acceptable reproducibility data ratios of 1.4 – 1.7.

4 Conclusions

The results of this collaborative trial showed that repeatability and reproducibility values for the determination of boiled wort colour are at an acceptable level. The precision data for the glycerol/oil bath boiling procedure are better than those obtained for the heating plate procedure, especially with respect to reproducibility. Based on these results the Analysis Committee of the European Brewery Convention has decided to recommend the evaluated method for incorporation in Analytica-EBC.

5 Zusammenfassung

Angelino, S.A.G.F.: Bestimmung der Kochfarbe – Monatsschrift für Brauwissenschaft 53, Nr. 3/4, 54 – 55, 2000

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Eine Methode zur Bestimmung der Kochfarbe wurde in einer Ringanalyse durch das Analysenkomitee der EBC untersucht. Bei diesem Versuch wurden das 14. EBC Standard-Malz und zwei kommerzielle Malzsorten in 21 Labors getestet. Für die Wiederholbarkeit (r_{95}) und die Reproduzierbarkeit (R_{95}) wurden die Werte von 0,33 – 0,42 und 1,12 – 1,44 EBC-Einheiten erreicht, bzw. ein durchschnittliches Niveau von 4,7 – 5,2 EBC-Einheiten. Bei einem Durchschnittsniveau von 8,9 EBC-Einheiten betragen die Werte jeweils 0,44 und 2,25 EBC-Einheiten. Die Dateneinstellungen ließen sich in zwei Unterkategorien aufteilen, in Labors, die entweder die Methode des Kochens auf einer heißen Platte, oder die Methode des Kochens in einem Glycerin/Ölbäd verwendet. Statistische Analysen beider Unterkategorien ergaben, daß die Reproduzierbarkeit bei der Methode des Kochens in einem Glycerin/Ölbäd für alle Niveaus eindeutig besser ist. Bei der Wiederholbarkeit ist die Situation weniger klar. Die beurteilte Methode wird für die Aufnahme in die Analytica-EBC empfohlen.

Angelino, S.A.G.F.: Détermination de la couleur du moût après cuisson – Monatsschrift für Brauwissenschaft 53, Nr. 3/4, 54 – 55, 2000

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La méthode de détermination de la couleur du moût après cuisson a été évaluée par le Comité des Analyses de l'EBC par un test inter-laboratoire. Pour cette évaluation on a testé le 14ème malt standard de l'EBC et deux malts commerciaux dans 21 laboratoires. On a atteint pour la répétabilité (r_{95}) et la reproductibilité (R_{95}) des valeurs de 0,33 – 0,42 et 1,12 – 1,44 EBC, respectivement un niveau moyen de 4,7 – 5,2 unités EBC. Par un niveau moyen de 8,9 unités EBC les valeurs s'élevaient respectivement à 0,44 et 2,25 unités EBC. L'établissement des résultats se décompose en deux sous-catégories: les laboratoires, qui d'une part utilisent la plaque chauffante pour la cuisson et d'autre part ceux qui utilisent le bain huile/glycérine pour la cuisson. Les analyses statistiques des deux sous-catégories donnaient les résultats suivants: la reproductibilité de la méthode de cuisson avec bain d'huile/glycérine était meilleure à tous les niveaux. Pour la répétabilité, la situation est moins claire. La méthode évaluée a été recommandée pour être intégrée dans Analytica EBC.

6 References

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4. White, F.H., Journal of the Institute of Brewing **101**, 431, 1995.