

DETERMINATION OF THE MOISTURE CONTENT OF BARLEY

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The method of the International Organization for Standardization, (ISO 712—1985) for the determination of moisture in cereals and cereal products, has been tested by members of the Analysis Committee of the European Brewery Convention on samples of barley. The method, which relies on loss in mass on drying at 130–133°C for 2 h, is recommended for use as a replacement for the current method, based on loss in mass on drying at 105–107°C for 3 h. It was judged that precision values were independent of concentration over the range 11 to 13% m/m. Repeatability (r_{95}) and Reproducibility (R_{95}) values of 0.13 and 0.55 respectively were obtained over this range. At a mean level of 21.7% m/m, the r_{95} and R_{95} values were 0.27 and 2.6 respectively. This was probably due to errors associated with the double drying technique which is necessary for samples at this moisture content.

Key Words: Collaborative trial, barley (analysis method for), moisture (determination of).

INTRODUCTION

The current European Brewery Convention (EBC) Recommended Method² for determining the moisture content of barley relies on the loss in mass on drying at 105–107°C for 3 h. This method applies to barley and not to other cereals, where different drying conditions are employed. To overcome problems due to these regimes, the International Organization for Standardization has introduced an International Standard for the determination of moisture in cereals and cereal products, viz. ISO 712—1985¹. This method is widely used by the grain industry for barley and relies on loss in mass on drying

at 130–133°C for 2 h. To harmonise the situation concerning the need for laboratories to operate two methods for determining the moisture content of barley, it was suggested that the Analysis Committee of the EBC consider adopting the ISO method. The Analysis Committee agreed to collaboratively test this method for the purpose of determining precision values.

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 5725³. A uniform design was employed and five samples of barley were circulated to 28 laboratories. One of the samples had a high

TABLE I. Raw data as received for the current EBC Method (units % m/m)

Laboratory	Sample 1		Sample 2		Sample 3		Sample 4		Sample 5	
1	11.46	11.49	12.73	12.94	12.46	12.62	12.53	12.40	21.88	21.40
2	11.47	11.44	13.04	13.03	12.58	12.58	12.32	12.34	21.72	21.76
3	11.28	11.36	12.92	12.89	12.36	12.42	12.35	12.29	20.51	20.50
4	11.37	11.54	13.11	13.26	12.78	12.85	12.69	12.82	21.91	21.98
5	11.05	11.02	12.28	12.22	12.12	12.08	11.82	11.89	20.79	20.37
6	11.46	11.42	12.86	12.80	12.42	12.36	12.23	12.16	21.33	21.32
7	11.42	11.55	13.22	13.27	12.78	12.77	12.68	12.69	21.60	21.60
8	11.76	11.76	13.42	13.51	13.00	13.04	12.68	12.78	21.88	21.91
9	11.60	11.58	13.00	12.99	12.70	12.69	12.54	12.47	21.83	21.73
10	11.67	11.63	13.41	13.30	12.87	12.74	12.79	12.70	21.64	21.60
11	11.64	11.61	13.22	13.24	12.75	12.75	12.70	12.67	21.61	21.57
12	11.61	11.63	13.33	13.34	12.75	12.77	12.59	12.57	21.81	21.94
13	11.86	11.79	13.21	13.18	12.56	12.34	12.95	13.01	21.68	21.43
14	11.15	11.16	12.78	12.54	12.19	12.15	11.92	11.93	21.29	21.34
15	11.44	11.47	13.14	13.10	12.60	12.66	12.54	12.59	21.43	21.35
16	11.18	11.13	12.75	12.69	12.24	12.23	11.63	11.88	21.81	21.78
17	11.56	11.36	13.23	12.94‡	12.67	12.50	12.57	12.36	21.78	22.42‡
18	11.44	11.35	12.65	12.56	12.23	12.34	12.12	12.11	21.85	21.73
19	11.50	11.43	13.12	13.10	12.67	12.60	12.57	12.46	21.51	21.45
20	11.63	11.62	13.33	13.26	12.84	12.85	12.68	12.69	22.09	21.95
21	11.16	11.20	12.60	12.56	12.20	12.17	11.75	11.75	21.48	21.48
22	11.60	11.60	13.24	13.20	—	—	12.62	12.62	21.90	21.90
23	11.31	11.24	12.97	13.03	12.32	12.35	12.56	12.56	21.31	21.50
24	11.72	11.70	13.23	13.14	12.70	12.67	12.56	12.67	21.90	21.93
25	11.34	11.40	12.84	12.84	12.50	12.49	12.30	12.36	22.76	22.50
26	11.71	11.70	13.41	13.39	12.90	12.90	12.79	12.76	21.78	21.87
27	11.58	11.58	13.17	13.20	12.74	12.70	12.43	12.45	22.02	22.00
28	11.53	11.53	13.11	13.16	12.62	12.63	12.74	12.78	21.06	20.89

‡ Identified as a straggler.

TABLE II. Raw data as received for the ISO 712—1985 Method (units % m/m)

Laboratory	Sample 1		Sample 2		Sample 3		Sample 4		Sample 5	
1	11.74	11.74	13.26	13.25	12.79	12.79	12.76	12.81	21.27	21.20
2	11.71	11.64	13.22	13.28	12.43	12.49	12.79	12.84	19.72	19.68
3	11.44	11.36†	12.59	12.47‡	12.17	11.98‡	11.97	11.80*	20.34	20.42
4	11.87	11.36	13.34	13.28	13.00	12.95	12.85	12.84	23.08	22.97
5	12.02	12.08	13.73	13.20*	13.18	13.04	13.08	13.03	22.33	22.29
6	12.13	12.09	13.76	13.78	13.21	13.19	13.21	13.13	20.39	20.78†
7	12.15	12.11	13.77	13.84	13.27	13.24	13.13	13.10	22.11	22.04
8	11.94	12.03	13.60	13.67	13.13	13.09	12.92	12.93	22.06	22.22
9	12.04	12.05	13.68	13.69	13.21	13.19	13.12	13.26	21.94	21.83
10	11.97	11.87	13.39	13.16†	12.86	13.00	12.92	12.81	22.09	22.74*
11	12.10	12.10	13.86	13.86	13.32	13.34	13.26	13.25	22.44	22.42
12	11.90	11.90	13.40	13.40	13.00	13.00	12.90	12.80	21.50	21.70
13	11.89	11.88	13.41	13.33	12.87	12.87	12.65	12.60	22.12	22.13
14	11.96	12.05	13.59	13.59	13.15	13.16	13.01	12.99	22.30	22.30
15	12.22	12.12	13.63	13.65	13.12	13.11	12.92	13.00	21.79	21.72

* rejected as an outlier.

† Identified as a straggler.

‡ Eliminated as not a normal distribution.

moisture content (21% m/m) which was used to test the pre-drying procedure. This sample was prepared by placing the barley in rotating drums, which were exposed to 100% water-saturated air. Prior to distribution, the sample was checked for homogeneity of moisture content and, for the purposes of the trial, was judged to be homogeneous. Participating laboratories were requested to determine the moisture content of the samples in duplicate to two places of decimals, using the ISO method and the current EBC procedure.

TABLE III. Summary of precision data for the current EBC Method (units % m/m)

Range	No. of Laboratories	r_{95}	R_{95}
11–13	27–28	0.16	0.74
21.5	28	0.39	1.3

TABLE IV. Summary of precision data for the ISO 712—1985 Method (units % m/m)

Range	No. of Laboratories	r_{95}	R_{95}
11–13	13–14	0.13	0.55
21.7	14	0.27	2.6

RESULTS AND DISCUSSION

The raw data, as received, are presented in Tables I and II. A summary of the results of a statistical treatment of the data obtained for each method is given in Tables III and IV. Three sets of data were identified as outliers and were rejected. A further three sets were eliminated as they did not lie within a normal distribution of the results. Since the range for samples 1 to 4 was less than expected, it was not possible to derive a precise relationship between r_{95} or R_{95} and m (mean level). Verification of r_{95} and R_{95} values for both methods demonstrated that better agreement was obtained for fixed values, which were independent of the mean levels. As expected, the ISO Method gave systematically higher results compared with those obtained by the current EBC procedure. Over the range 11 to 13% m/m, the difference is 0.4% m/m. However, at the higher level the difference is considered to be less important.

When moisture values, produced by the ISO Method, are employed in the calculation of a constituent of barley on a dry weight basis, e.g. total nitrogen, it must be recognised that a slightly higher result will be obtained, compared to that given using the current EBC Method. Clearly, the ISO Method cannot be applied to malt, since caramelisation would occur at the higher temperatures of 130 to 133°C.

CONCLUSION

The Analysis Committee of the EBC judged as acceptable both the repeatability and reproducibility values for moisture in barley obtained by the International Standard ISO 712—1985 method. The Committee has approved the inclusion in ANALYTICA-EBC of the ISO 712—1985 method for determining the moisture in barley. This method replaces the current EBC Method based on drying at 105–107°C for 3 h, which has been transferred to the archive section of ANALYTICA-EBC.

REFERENCES

1. Cereals and cereal products. *Determination of moisture content (routine reference method)*, ISO 712—1985.
2. European Brewery Convention. *Analytica-EBC, 1987*, Method 3.1.
3. International Standard, ISO 5725, *Precision of test methods, second edition*, 1986.