

USE OF FILTER PAPERS IN MALT ANALYSIS

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The filter papers listed under the method for extract determination, 4.4 Extract, in *Analytica IV* have been tested in order to reveal if the type of filter paper has any effect on the analytical results. The data received from ten participating laboratories indicate that the standard deviations of the analytical results are somewhat dependent upon the type of filter paper used. The four filter papers tested gave substantial variations in speed of filtration. The results indicate that the type of filter paper to be used must be specified in collaborative tests. It is recommended that section 4.4 and 4.4.3 should be re-evaluated.

Key Words:

INTRODUCTION

In the latest edition of *Analytica-EBC*, edition IV, under the method for extract content of malt, 4.4 Extract, the filter papers stipulated are as follows: Fluted filter papers 320 mm diameter. Schleicher and Schuell No. 597 1/2, Machery, Nagel & Co. No. 614 1/4, F.C. Binzer No. 12 and 53 or equivalent.

In the first edition of *Analytica-EBC* (1953) five makes of filter papers are mentioned with the comment: "or equivalent papers from other firms". In the second edition (1963) the number of filter papers are reduced to three. In the third edition (1975) the list of filter papers is identical to the one in the latest edition. In all four editions both Schleicher and Schuell No. 597 1/2 and Machery, Nagel & Co. No. 614 1/4 are among the filter papers mentioned.

The aim of this work was to test the fluted papers listed in the latest edition of *Analytica-EBC* to see if the type of filter paper used has any influence on the analytical results, including speed of filtration.

TESTING PROCEDURE

The test was carried out with the 12th EBC Standard Malt. In order to obtain additional information about speed of filtration, the ten participants were asked to select two local malts from their own collection. Preferably one malt with a high degree of modification and one malt of a more undermodified character.

All participants were sent samples of the four filter papers to be tested.

Filter paper no.

- 1 Schleicher & Schuell No. 597 1/2
- 2 Machery, Nagel & Co. No. 614 1/4
- 3 F. C. Binzer No. 12
- 4 F. C. Binzer No. 53

For all four filter papers, and the three malts, the following data were reported in duplicate: extract, viscosity, colour (visual 8.3.1) and haze (absorbance at 700 nm). The filtration rate was reported as time in sec. for the first 100 ml collected, and also the time in min. for 200 ml collected after the first 100 ml of the filtrate had been returned to the funnel.

A statistical evaluation of the malt analysis data was only carried out for the 12th EBC Standard Malt, malt no. 1. Malts 2 and 3 with different degrees of modification were used to support data on the observed speed of filtration only.

The degree of modification and the homogeneity of malt samples 2 and 3 were indicated by reporting Friability (%) and Partly Unmodified Grains (PUG, %). The mean value for Friability and PUG was for malt 2: 82.7% and 3.6% respectively. The mean values for malt 3 indicated a substan-

TABLE I. Extract Values Obtained from the 12. EBC Std. Malt with Filter Papers 1–4

| Filter paper no. | 1 | 2 | 3 | 4 |
|---------------------|-------|-------|-------|-------|
| Collaborator | | | | |
| 1 | 81.1 | 81.1 | 81.2 | 81.2 |
| 2 | 81.7 | 81.8 | 81.7 | 81.7 |
| 3 | 81.4 | 81.6 | 81.7 | 81.8 |
| 4 | 81.6 | 81.4 | 81.8 | 81.4 |
| 5 | 81.0 | 81.4 | 81.7 | 81.7 |
| 6 | 80.9 | 81.3 | 80.8 | 80.4 |
| 7 | 81.3 | 80.8 | 81.3 | 80.4 |
| 8 | 81.1 | 81.2 | 81.1 | 81.0 |
| 9 | 81.3 | 81.4 | 81.5 | 81.4 |
| 10 | 81.1 | 81.1 | 81.1 | 80.5 |
| Mean | 81.25 | 81.31 | 81.39 | 81.15 |
| Std. Dev. S | 0.259 | 0.281 | 0.338 | 0.550 |
| Coeff. of Var., CV% | 0.319 | 0.346 | 0.415 | 0.678 |

TABLE II. Viscosity Values of the 12. EBC Std. Malt Obtained with Filter Papers 1–4

| Filter paper no. | 1 | 2 | 3 | 4 |
|---------------------|--------|--------|--------|--------|
| Collaborator | | | | |
| 1 | 1.57 | 1.58 | 1.57 | 1.58 |
| 2 | 1.58 | 1.59 | 1.58 | 1.60 |
| 3 | 1.58 | 1.59 | 1.60 | 1.62 |
| 4 | 1.59 | 1.59 | 1.61 | 1.58 |
| 5 | 1.60 | 1.61 | 1.63 | 1.63 |
| 6 | 1.60 | 1.66 | 1.66 | 1.63 |
| 7 | 1.59 | 1.59 | 1.59 | 1.55 |
| 8 | 1.53 | 1.55 | 1.54 | 1.52 |
| 9 | 1.55 | 1.55 | 1.56 | 1.56 |
| 10 | 1.59 | 1.60 | 1.56 | 1.57 |
| Mean | 1.578 | 1.591 | 1.590 | 1.584 |
| Std. Dev. S | 0.0225 | 0.0311 | 0.0362 | 0.0363 |
| Coeff. of Var., CV% | 1.426 | 1.955 | 2.277 | 2.292 |

tially lower degree of modification: 73.3% and 6.9% respectively. The participants had accordingly selected the malt samples 2 and 3 as requested.

In this test the participating laboratories received only one malt sample, the 12th EBC Standard Malt. This was judged to be acceptable as the aim was to observe possible deviations in the data obtained with the four recommended filter papers. For the purpose of this test the results are reported in terms of standard deviation and coefficient of variation.

TABLE III. Colour, EBC-Units, of the 12. EBC Std. Malt Obtained with Filter Papers 1-4

| Filter paper no. | 1 | 2 | 3 | 4 |
|---------------------|--------|--------|--------|--------|
| Collaborator | | | | |
| 1 | 3.6 | 3.7 | 3.6 | 3.7 |
| 2 | 3.9 | 3.9 | 3.8 | 3.9 |
| 3 | 4.4 | 4.4 | 4.4 | 4.7 |
| 4 | — | — | — | — |
| 5 | 3.8 | 3.7 | 3.7 | 3.7 |
| 6 | 4.6 | 4.5 | 4.9 | 5.2 |
| 7 | 3.8 | 5.0 | 3.9 | 4.9 |
| 8 | 4.2 | 4.2 | 4.2 | 4.2 |
| 9 | 5.8 | 5.3 | 5.6 | 5.6 |
| 10 | 4.4 | 4.4 | 4.4 | 4.4 |
| Mean | 4.28 | 4.34 | 4.28 | 4.48 |
| Std. Dev. S | 0.663 | 0.550 | 0.646 | 0.674 |
| Coeff. of Var., CV% | 15.498 | 12.661 | 15.101 | 15.051 |

RESULTS AND DISCUSSION

Results from the collaborators for extract, viscosity, colour and haze with the filter papers 1-4 are shown in Tables I-IV.

TABLE IV. Haze of Worts Obtained with Filter Papers 1-4, 12. EBC Std. Malt

| Filter paper no. | 1 | 2 | 3 | 4 |
|---------------------|---------|--------------------|---------|---------|
| Collaborator | | | | |
| 1 | — | — | — | — |
| 2 | 0.040 | 0.045 | 0.044 | 0.042 |
| 3 | 0.047 | 0.048 | 0.057 | 0.068 |
| 4 | — | — | — | — |
| 5 | 0.045 | 0.047 | 0.046 | 0.046 |
| 6 | 0.048 | 0.044 | 0.052 | 0.049 |
| 7 | 0.046 | 0.086 ^a | 0.042 | 0.047 |
| 8 | 0.037 | 0.060 | 0.060 | 0.058 |
| 9 | 0.044 | 0.042 | 0.045 | 0.044 |
| 10 | 0.055 | 0.057 | 0.053 | 0.056 |
| Mean ^b | 0.0453 | 0.0490 | 0.0499 | 0.0513 |
| Std.Dev. S | 0.00539 | 0.00683 | 0.00658 | 0.00876 |
| Coeff. of Var., CV% | 11.912 | 13.939 | 13.194 | 17.093 |

^aOutlier at a 1% level
^bMean calculated excluding outlier

There are some, but according to an F-test not significant difference in the mean values observed between the filter

types. The more striking difference is, however, the coefficients of variation which for extract, viscosity and haze are lower for filter paper 1 than for filter paper 2, 3 and 4. Filter paper 4 gives the highest coefficient of variation values in all three sets of data.

Even more interesting is the data collected for the speed of filtration where a significant difference in filtration speed can be observed between the four filter papers. The mean time to collect 200 ml is 27 minutes for filter paper type 1 and only 6 minutes when filter paper no. 4 was used. A closer inspection of table V reveals, however, that there are substantial variations between the laboratories. One laboratory is down to 9 minutes with the "slow" filter paper no. 1, whereas the other laboratory obtained 14 minutes with the "quick" filter paper no. 4.

In spite of these substantial variations between the collaborators, Figure 1 reveals that the mean time of filtration for 200 ml wort is highly filter paper dependent and is not significantly affected by the physical modification of the malt samples used in this test.

CONCLUSIONS

The results obtained in this collaborative test indicate that the type of filter paper used can affect the results of the malt analysis. In the determination of extract, viscosity and haze,

TABLE V. Speed of Filtration, four Filter Papers, 12. EBC Std. Malt

| Filter paper no. | Time to Collect First 100 ml (sec.) | | | | Time to Collect 200 ml (min.) | | | |
|------------------|-------------------------------------|-------|-------|------|-------------------------------|------|------|-----|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Collaborator | | | | | | | | |
| 1 | 430 | 205 | 148 | 98 | 46 | 25 | 22 | 9 |
| 2 | 88 | 73 | 58 | 30 | 9 | 8 | 6 | 3 |
| 3 | 145 | 128 | 128 | 95 | 15 | 14 | 12 | 5 |
| 4 | 233 | 195 | 197 | 66 | 28 | 23 | 20 | 6 |
| 5 | 89 | 71 | 73 | 41 | 9 | 7 | 6 | 3 |
| 6 | 380 | 401 | 235 | 121 | 72 | 77 | 34 | 14 |
| 7 | 135 | 95 | 122 | 37 | 13 | 9 | 14 | 3 |
| 8 | 229 | 142 | 117 | 69 | 41 | 14 | 13 | 5 |
| 9 | 188 | 158 | 130 | 89 | 20 | 14 | 12 | 4 |
| 10 | 191 | 139 | 166 | 53 | 21 | 16 | 20 | 5 |
| Mean | 210.8 | 160.7 | 137.4 | 69.9 | 27.4 | 20.7 | 15.9 | 5.7 |
| High | 430 | 401 | 235 | 121 | 72 | 77 | 34 | 14 |
| Low | 88 | 71 | 58 | 30 | 9 | 7 | 6 | 3 |

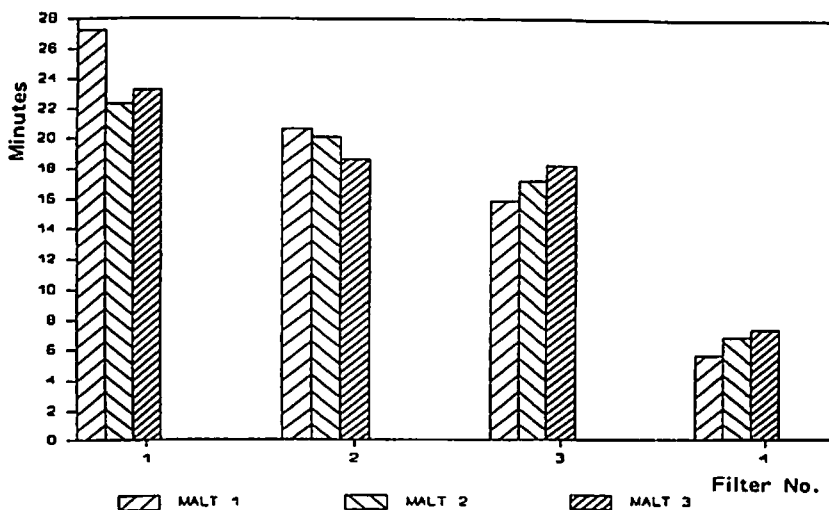


Fig. 1. Filtration time in min. for 200 ml collected with the four filter papers. Mean values for 10 collaborators for malt 1 (12 Std. Malt) and malt 2 and 3 (variable malts of own selection).

filter paper no. 4 clearly gives a higher coefficient of variation than filter paper no. 1.

The speed of filtration depends greatly on the filter paper used. The filtration time should never be expressed in minutes, and even the coarse evaluation of speed of filtration

as either "normal" or "slow" is questionable if the type of filter paper is not mentioned.

According to these observations the list of recommended filter papers and the section Speed of Filtration in Analytica IV should be re-evaluated.