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# THE DETERMINATION OF BEER COLOUR—COLLABORATIVE TRIAL

SUBMITTED ON BEHALF OF THE INSTITUTE OF BREWING ANALYSIS COMMITTEE BY J. C. SEATON AND I. C. CANTRELL

**The data and analyses on which the Institute of Brewing based its decision to modify its method for the determination of beer colour are presented. Spectrophotometric measurements at 430 nm are shown to be more precise than measurements made at 530 nm or by using comparators. The Institute of Brewing Analysis Committee recommends that measurement at 430 nm is adopted. Equations relating precision to beer colour determinations at 430 nm are advanced.**

Key Words: *Colour, spectrophotometer, comparator, precision.*

## INTRODUCTION

This paper relates to a collaborative trial, initiated and undertaken in 1982 under the auspices of the Institute of Brewing, to investigate the measurement of beer colour. The trial was designed to compare and correlate the Comparator procedure, the EBC Recommended Procedure with measurement at 430 nm. and the then I.O.B. Recommended Procedure with measurement at 530 nm. Subsequently the I.O.B. method has been amended to include measurement at 430 nm. and this is the method now included in the 1991 Revision of the Institute of Brewing Methods.

The design of the trial was structured around the procedures of ISO 5725[1] and in this sense was at the forefront of modern thinking in terms of the design and analysis of collaborative trials. For this reason, and for the sake of completeness of the scientific record, the Analysis Committee has taken the decision to publish the data obtained and their associated statistical analyses in spite of the time which has elapsed since the trial work was completed.

## EXPERIMENTAL

Eight packaged beers (factor levels 1 to 8) with colours ranging from approximately 8 to 66 EBC units were circulated to 10 laboratories. For each beer, participants were requested to make duplicate determinations of beer colour by three variants of the method.

The variants of the beer colour method were:

1. Determination of absorbance by spectrophotometer at 430 nm (EBC Recommended Method Wavelength)
2. Determination of absorbance by spectrophotometer at 530 nm (I.O.B. Recommended Method Wavelength)
3. Visual assessment using Comparators (Lovibond or Hellige)

Samples were prepared for colour determination according

TABLE 1. Summary of data received showing experimentally determined values for each level by each of the three methods

| Laboratory | Level 1 | | Level 2 | | Level 3 | | Level 4 | | Level 5 | | Level 6 | | Level 7 | | Level 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| Spectrophotometer at 430 nm. (absorbance values) | | | | | | | | | | | | | | | | |
| 1 | 0.362 | 0.361 | 0.341 | 0.350 | 0.678 | 0.679 | 1.434 | 1.426 | 1.028 | 1.030 | 0.936 | 0.922 | 1.978 | 1.964 | 2.176 | 2.156 |
| 2 | 0.355 | 0.334 | 0.340 | 0.319 | 0.650 | 0.625 | 1.350 | 1.346 | 1.020 | 0.954 | 0.900 | 0.867 | 1.889 | 1.822 | 2.190 | 2.045 |
| 3 | 0.376 | 0.376 | 0.357 | 0.358 | 0.697 | 0.690 | 1.432 | 1.373 | 1.075 | 1.075 | 0.952 | 0.949 | 2.025 | 2.025 | 2.220 | 2.220 |
| 4 | 0.383 | 0.378 | 0.348 | 0.360 | 0.699 | 0.687 | 1.456 | 1.491 | 1.053 | 1.085 | 0.954 | 0.980 | 2.116 | 2.024 | 2.306 | 2.284 |
| 5 | 0.390 | 0.386 | 0.364 | 0.373 | 0.698 | 0.698 | 1.440 | 1.410 | 1.060 | 1.070 | 0.970 | 0.978 | 2.030 | 2.010 | 2.310 | 2.130 |
| 6 | 0.365 | 0.366 | 0.343 | 0.343 | 0.674 | 0.679 | 1.442 | 1.445 | 1.036 | 1.033 | 0.933 | 0.958 | 1.972 | 1.976 | 2.210 | 2.190 |
| 7 | 0.360 | 0.361 | 0.342 | 0.350 | 0.670 | 0.680 | 1.470 | 1.480 | 1.030 | 1.020 | 0.902 | 0.900 | 2.000 | 2.000 | 2.180 | 2.180 |
| 8 | 0.366 | 0.367 | 0.350 | 0.342 | 0.680 | 0.671 | 1.449 | 1.320 | 1.040 | 1.020 | 0.943 | 0.925 | 2.046 | 2.030 | 2.236 | 2.230 |
| 9 | 0.383 | 0.386 | 0.363 | 0.368 | 0.701 | 0.706 | 1.480 | 1.444 | 1.066 | 1.066 | 0.959 | 0.962 | 2.036 | 2.020 | 2.224 | 2.216 |
| 10 | 0.382 | 0.383 | 0.359 | 0.364 | 0.689 | 0.709 | 1.438 | 1.420 | 1.040 | 1.064 | 0.946 | 0.951 | 1.928 | 2.048 | 2.112 | 2.234 |
| Spectrophotometer at 530 nm. (absorbance values) | | | | | | | | | | | | | | | | |
| 1 | 0.081 | 0.078 | 0.077 | 0.081 | 0.155 | 0.156 | 0.360 | 0.364 | 0.326 | 0.329 | 0.240 | 0.235 | 0.559 | 0.555 | 0.775 | 0.767 |
| 2 | 0.080 | 0.075 | 0.085 | 0.080 | 0.155 | 0.155 | 0.345 | 0.364 | 0.345 | 0.325 | 0.245 | 0.240 | 0.575 | 0.561 | 0.800 | 0.770 |
| 3 | 0.085 | 0.086 | 0.087 | 0.085 | 0.169 | 0.164 | 0.350 | 0.309 | 0.341 | 0.338 | 0.250 | 0.248 | 0.581 | 0.580 | 0.773 | 0.773 |
| 4 | 0.097 | 0.085 | 0.080 | 0.083 | 0.166 | 0.156 | 0.369 | 0.361 | 0.334 | 0.344 | 0.251 | 0.258 | 0.568 | 0.572 | 0.782 | 0.806 |
| 5 | 0.096 | 0.094 | 0.087 | 0.094 | 0.171 | 0.167 | 0.369 | 0.339 | 0.335 | 0.343 | 0.263 | 0.257 | 0.568 | 0.580 | 0.768 | 0.790 |
| 6 | 0.074 | 0.080 | 0.076 | 0.073 | 0.145 | 0.153 | 0.348 | 0.358 | 0.326 | 0.327 | 0.231 | 0.257 | 0.560 | 0.561 | 0.770 | 0.768 |
| 7 | 0.072 | 0.078 | 0.068 | 0.060 | 0.144 | 0.150 | 0.348 | 0.350 | 0.308 | 0.310 | 0.221 | 0.220 | 0.530 | 0.536 | 0.736 | 0.740 |
| 8 | 0.079 | 0.080 | 0.079 | 0.077 | 0.150 | 0.149 | 0.376 | 0.284 | 0.329 | 0.322 | 0.245 | 0.235 | 0.557 | 0.549 | 0.771 | 0.763 |
| 9 | 0.083 | 0.083 | 0.082 | 0.083 | 0.162 | 0.168 | 0.381 | 0.354 | 0.335 | 0.334 | 0.245 | 0.249 | 0.571 | 0.568 | 0.776 | 0.775 |
| 10 | 0.090 | 0.091 | 0.082 | 0.090 | 0.164 | 0.186 | 0.355 | 0.345 | 0.332 | 0.341 | 0.249 | 0.252 | 0.564 | 0.590 | 0.760 | 0.784 |
| Comparator (colour units EBC) | | | | | | | | | | | | | | | | |
| 1 | 8.5 | 9.0 | 7.0 | 8.0 | 16.5 | 16.0 | 32.5 | 32.5 | 28.0 | 27.5 | 23.5 | 24.0 | 50.0 | 50.0 | 60.0 | 50.0 |
| 2 | 9.0 | 8.5 | 8.5 | 8.5 | 15.5 | 16.0 | 32.5 | 35.0 | 27.5 | 26.0 | 22.0 | 22.5 | 52.5 | 52.5 | 65.0 | 65.0 |
| 3 | 10.0 | 10.0 | 9.5 | 9.0 | 18.0 | 18.0 | 40.0 | 40.0 | 29.0 | 29.5 | 23.0 | 24.0 | 56.0 | 56.0 | 67.5 | 67.5 |
| 4 | 10.0 | 9.5 | 8.0 | 9.5 | 19.5 | 19.5 | 40.0 | 37.5 | 27.5 | 27.5 | 25.5 | 24.5 | 60.0 | 61.0 | 67.5 | 67.5 |
| 5 | 9.0 | 9.0 | 8.0 | 8.0 | 17.0 | 18.0 | 37.0 | 37.0 | 32.0 | 28.0 | 23.0 | 23.0 | 55.0 | 56.0 | 64.0 | 65.0 |
| 6 | 8.4 | 8.0 | 8.1 | 8.2 | 16.1 | 16.0 | 36.9 | 37.1 | 33.4 | 33.0 | 24,3 | 24.5 | 57.0 | 56.3 | 76.3 | 77.2 |