

Abstract

The purpose of the study was to test beer (and wort) color measurement with automated Thermo Scientific Gallery analyzer by using 430 nm filter. Results of the Gallery analyzer were compared to the results measured with manual spectrophotometer.

From the 7 beer samples (n= 10) precision of the color measurement was very good. CV% of all measured samples was also very good, < 0.15 %. Measuring range for the beer color test was determined as 5 – 50 EBC units without dilution and up to 200 EBC with a automated predilution of 1+3. Correlation between two Gallery analyzers or two 430 nm filters was excellent (r= 0.991). Bias between color results of two filter was detected as 0 – 1 %. As a Method comparison result, Gallery and reference method (manual spectrophotometer) gives very good correlation. With this Gallery automated analyzer we were additionally able to perform several other beer analysis from the same sample in very short time.

Introduction

In general, most common beer color is a pale amber (EBC unit ≤ 12). Beer color originates mainly from the malt, but also other factors can affect Beer Color. Naturally dark beers are usually brewed from a pale malt or lager malt base with a small proportion of darker malt added to achieve the desired shade. Very dark beers, such as stout, use dark or patent malts that have been roasted longer.

Other factors that can affect the beer color are mainly increased pH, Maillard reaction or oxidation. When wort is boiled, color increases. Also fermentation can deposit proteins in beer that can create a change in color. Color can change also with the yeast strain selected, filtration can reduce color or oxidation can deepen beer color. Sometimes colorants, such as caramel, is used to darken beer.

The system used to characterize beer color has its origins in the late 1800's. The original lovibond system used colored slides that were compared to the beer color to determine approximate value. By the mid-20'th century, light spectrophotometer technology was developed. In 1950 visual system called the European Brewing Convention (EBC) was created. This method uses nowadays a spectrophotometer with wavelength of 430 nm. There is also another spectrophotometric color system, the Standard Reference Method (SRM), adopted by the ASBC (American Society of Brewing Chemists). Conversion factor SRM = 0.377 x EBC + 0.45 can be used to convert EBC unit to SRM units.

The instrumental EBC method is the official reference method for wort and beer color measurement in Europe (1).

Materials and Methods

Thermo Scientific Gallery (manufactured by Thermo Fisher Scientific), is a new discrete photometric analyzer, a fully automated bench-top system. The beer color method of the Gallery analyzer was compared with manual spectrophotometer Shimadzu MultiSpec – 1501 (Element resolution < 1.5 nm, Wavelength accuracy ± 1.0 nm).

Several beers from different countries were tested. Some sample pretreatments, like filtration through a membrane filter and addition of "kieselguhr" before the membrane filtration, were also tested.

SAMPLE PRETREATMENT: Tested pretreatments were syringe filtration with 0.45 µm membranefilter alone and "kieselguhr" addition before filtration.

PRECISION: Precision was done by measuring each seven beer samples ten (10) times.

LINEARITY: For linearity / measuring range test, the dark beer samples were diluted with pale beer or with deionized water. Lowest and highest samples were measured with manual spectrophotometer. Color of the diluted samples between those two measured samples were calculated according to the dilution ratio. All samples were measured three times with the Gallery analyzer.

METHOD COMPARISON: Seven beer samples were measured with two Gallery analyzers and manual spectrophotometer.

Results

SAMPLE PRETREATMENT: Most beer samples gave same result without pretreatment and with syringe filtration with 0.45 µm membranefilter when measured with Gallery. Instead bubbles on the wall of the cuvette interfered manual spectrophotometric measurement of untreated beer samples. The use of kieselguhr didn't have remarkable effect on results. The advance of adding kieselguhr was easier filtration of dark beers.

PRECISION: Precision of the color measurement was very good. CV% of all measured samples was < 0.15 %.

LINEARITY: Measuring range is 5 – 50 EBC without dilution and up to 200 EBC with automated dilution 1+3.

METHOD COMPARISON: Method comparison between Gallery and the reference method (manual spectrophotometer) gave good results. Average bias between measured samples was – 5 %.

Correlation between two Gallery analyzers or two 430 nm filters is excellent. Bias between color results of two filter is 0 – 1 %.

Table 1. Precision

Mean (EBC), N = 10	SD	CV%
5,6	0,005	0,10
8,9	0,007	0,08
12,0	0,011	0,09
15,7	0,014	0,09
35,5	0,044	0,12
41,1	0,044	0,11
104,1	0,092	0,09

Figure 1. Linearity

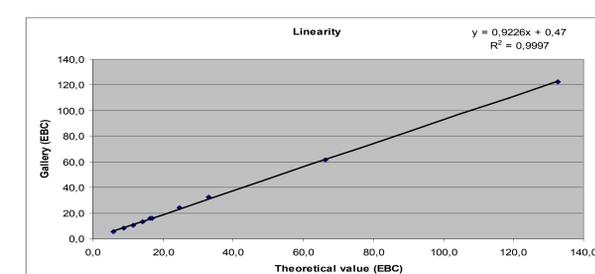
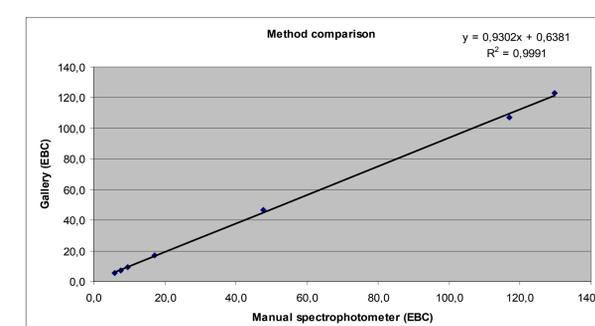


Figure 2. Method comparison



Conclusion

Thermo Scientific Gallery analyzer is suitable for beer color measurement by official EBC reference method (1). The advance of using automated analyzer is the usability to measure many analytes in addition of color measurement from the same sample. The results of all measured analytes can be printed to the same report.

Reference

1. Analytica-EBC Method 8.5 Colour of Wort: Spectrophotometric Method (IM) and Method 9.6 Colour of Beer: Spectrophotometric Method (IM)