2017 ASBC Annual Meeting

What Color is Your Beer?

Using a Different Language to Measure Beer Color

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Abstract

The key industry challenges for the appearance measurement of beer are:

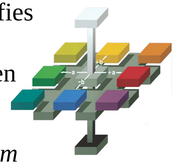
- Current ASBC color measurement method does not reproduce how the eye sees color
- Visual systems of beer color assessment are subjective
- ASBC Number is a single wavelength measurement using spectrophotometer
- A beer color number can be the *same* for products that are visually *different*
- Can a beer with same color number appear different?

Introduction

Color change in a beer product is and indication of overall quality including raw material change (malt and hops) or process variation (Maillard Reaction, caramelization, etc.).

The ASBC reference method for color is based on:

- Spectral absorbance measurement at 430 nm of clarified beer using a UV-VIS spectrophotometer
- In the ASBC Beer Color scale, the higher the value, the darker the beer
- CIE Colorimetry defines color across the visible region, combines illumination and human observer functions
- The CIE L*a*b* scale describes, quantifies and communicates color. **L*** value is lightness/darkness, **a*** values is red/green and **b*** value is yellow/blue.



The L,a,b color diagram

Methods

To test the correlation of visual to color number, the quantitative method uses a color spectrophotometer to measure the absorbance/transmission spectrum of a variety of beers

- The spectrum is converted into L*a*b* values which quantify the color
- The spectral data is also used to report the ASBC Beer Color Number and ASBC Turbidity Number

Experimental:

- Twelve different beers – samples collected and clarified
- Measure with ASBC Color Scale
- Measure with EBC Color Scale
- Measure with CIE L*a*b* Scale
- Measure in 10mm cell per the ASBC Method
- Also provide ASBC Turbidity value (ratio of 430nm/700nm value)
- Samples aligned by decreasing color, increasing ASBC Number (see right)

Results

Color data, turbidity, and spectral info for each beer are reported (Table 1).

- Generally, ASBC Beer Color Number reported samples in order (lighter to darker). CIE L*a*b* values also aligned as expected. However:
- Samples 2 and 4 had identical ASBC Color but different L*a*b*. Samples are quantitatively and visually different:
  ΔL* = 2.62, Δb* = 2.37, Δa* = 1.84
- Samples 9 and 10 had similar ASBC Color Number but significantly different quantitative L* and b* values and visually very different:
  ΔL* = 7.16, Δa* = 0.56, Δb* = 11.51
- Spectral curves diverge further into visible region, especially at 700nm

Discussion

1. Using established color science, an analytical method can be utilized for precise color (and turbidity) evaluation of beer. Colorimetry evaluates color as human visual assessment and quantifies color into easily understood terminology.

2. There can be large differences between L*a*b* and ASBC Color Number in dark beers. Where ASBC Color Numbers are identical, the L*a*b* values are significantly different. This can be seen visually as well. For lighter beers, there are some quantitative and visual differences between L*a*b* and ASBC Color Number.

3. Both ASBC Color and CIE colorimetry use objective spectral information as a basis. Both are better than visual assessment. CIE Color Scales, such as the commonly utilized L*a*b* scale, offer complete quantification of color across all beer products. Both scales can be utilized simultaneously and with turbidity values. L*a*b* would be recommended for darker beers.

Table 1 Color Values and spectral curves of beer samples

ID	L*	a*	b*	ASBC	ASBC Turbidity	EBC
Sample 1	95.47	-1.40	17.40	3.1	free of turbidity	6.0
Sample 2	91.82	-0.22	27.62	5.3	free of turbidity	10.3
Sample 3	91.18	0.19	28.70	5.5	free of turbidity	10.9
Sample 4	89.20	1.62	25.25	5.3	turbid	10.5
Sample 5	83.63	1.90	37.79	8.8	turbid	17.4
Sample 6	80.18	8.29	63.37	16.2	free of turbidity	32.0
Sample 7	64.60	22.84	79.52	30.8	free of turbidity	60.6
Sample 8	66.85	23.39	85.12	32.5	free of turbidity	64.1
Sample 9	32.32	33.89	54.45	53.2	turbid	104.7
Sample 10	25.16	33.33	42.94	53.5	turbid	105.3
Sample 11	28.58	35.93	48.76	56.1	turbid	110.4