Method OIV-MA-BS-27 : R2009
Type IV method

Determination of chromatic characteristics in spirit drinks of viti-vinicultural origin

OENO 6/94
OIV/OENO 382A/2009

1. Definitions

The chromatic characteristics of an alcoholic beverage are its luminosity and its chromaticity. Luminosity corresponds to the transmittance that varies inversely with colour intensity. Chromaticity corresponds to the dominant wavelength (hue) and purity.

Theoretical monochromatic components referred to as X, Y, Z, were defined by the International Commission on Illumination in 1931 (CIE). Each colour is therefore defined by its coordinates X, Y, Z in a system of three axes (also referred to as tristimulus values) forming between them an equal angle.

The trichromatic coordinates of any colour stimulus are obtained from the ratio of one component to the sum of all three, such that $x = X / (X + Y + Z)$, just as $y = Y / (X + Y + Z)$, etc.

It is therefore possible to reduce the spatial configuration of the colour in a flat presentation.

To fully define the colour, the notion of intensity is lacking, although the value Y is directly proportional to the visual intensity perceived by the human eye.

The colour of a solution is therefore fully defined by

- x, y, and Y (CIE 1931)

However, this space is not homogeneous and it is very difficult to correlate a chromatic gamut and a visual gamut.

Since this technique is not ultimately used, mathematicians have tried to define a new space that is more consistent referred to as L*,

L (psychometric clarity) is defined from Y; u and v being derived from X, Y and Z as well as from Xn, Yn, Zn the chosen surface colour as the nominal white stimulus under the illuminant used for the measurement. (CIE 1976).

The work of Adams-Nickerson enables the definition of a new space referred to as L*, a*, b* based on the same tristimulus values X, X, Y, etc.

It is represented by a sphere (Fig. 2) materialised by three axes L which vary from 0 for the white to 100 for the black, a* (-a = green, +a = red) and b* (-b = blue, +b = yellow).

- Clarity is defined by the value of L,
- Purity or chroma or saturation is the value C = (a2 + b2)1/2
- The hue angle, h = tg-1 (b/a).

Fig.2 Representation of colour in space L*, a*, b*.

The difference between two colours is measured by the relationship (total chromatic gamut)

AE= [(AL)2 + (Aa)2 + (Ab)2] 1/2 = [(AL)2 + (AC)2 + (Ah)2] 1/2

- The "chroma" gamut AC = [(C1)2 +(C2)2]1/2
- The clarity gamut AL = [(L1)2 +(L2)2]1/2
- The difference in hue Ah = [(AE)2 - (AL)2 - (AC)2] 1/2

The illuminants. As a result in particular of the observation of surface colours (introduced in the measurement of Xn, Yn and Zn) it was necessary to know the spectral distribution of the illumination used. At present, the illuminant the most commonly used is the illuminant D 65 (Daylight colour close to 6504°K). Spectral distributions neighbouring the theoretical illuminant are obtained with tungsten or xenon arc lamps.

Transmission measurements. It is possible to work with an illumination angle and a viewing angle, but in fact, it is preferable to work in conditions that can be most easily normalised, namely illumination at 0° and observation at 0 ° (or 180°), observation being from the side opposite to that which is illuminated and in the extension of the axis of the illuminating beam. (less than 5° in deviation) this type of measurement is called "0/0".

2. Measurement of colour

2.1. Choice of an illuminant At present, it is recommended to choose the illuminant D65 although the illuminant C leads to very similar results.

2.2. Calculation of tristimulus values X, Y, Z. These tristimulus values of a colour stimulus can be determined from the summation of values calculated for a wavelength ranging from 380 to 770 nm (minimum) and with a measurement at least every 5 nm (in some cases , a measurement every 20 nm may be acceptable).

Refer to the Compendium of International Methods of Analysis of the OIV: Determination of chromatic characteristics according CIELab. *Resolution* OENO 1/2006

2.3. Carry out the calibration of the appliance using a vessel suitable to the spectrophotometer or colorimeter used. The size of the tank depends on the colour intensity of the alcoholic beverage (in principle 10 mm, exceptionally 1 mm or on the contrary 20 mm). The calculations are performed based on the transmittance values for an optical path length of 10 mm, when other optical path lengths are used the absorbance must be measured and rounded off to an optical path length of 10 mm and then the transmittance calculated.

2.4. Perform the measurement on the alcoholic beverage

Theoretically the sample should not be filtered if it is a product intended for direct consumption, because a certain degree of opacity and can be sought and expressed directly by L; care, however, should be taken to ensure that the sample is free of particles that are not a priori contained in the alcoholic beverage, especially those resulting from corking. Perform the measurement. Record the results.

2.5. Make colour comparisons

If appropriate, if the appliance used allows comparisons of colour, for example in relation to a chosen reference standard and thus directly determine

- the purity gamut AC
- the clarity gamut AL
- the difference in hue Ah

3. Expression of results

- The reference of illuminant A, C, or D65
- The optical path length under which the measurement is made, - the luminosity L*.
- The values of a* and b*,
- The purity or saturation C, - the hue angle h.

For comparative measurements, note

- The purity gamut AC
- The clarity gamut AL
- The difference in hue Ah

4. Bibliography

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4. International Commission on Illumination (CIE, 1976)

5. The Compendium of International Methods of Analysis of the OIV: Determination of chromatic characteristics according to CIELab. *Resolution* Oeno 1/2006.

Figure 1 Representation of the different parameters of the colour