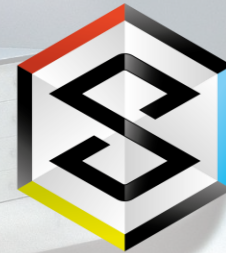


***Color measurement
with the CIELab method***

SMART
SMART ANALYSIS



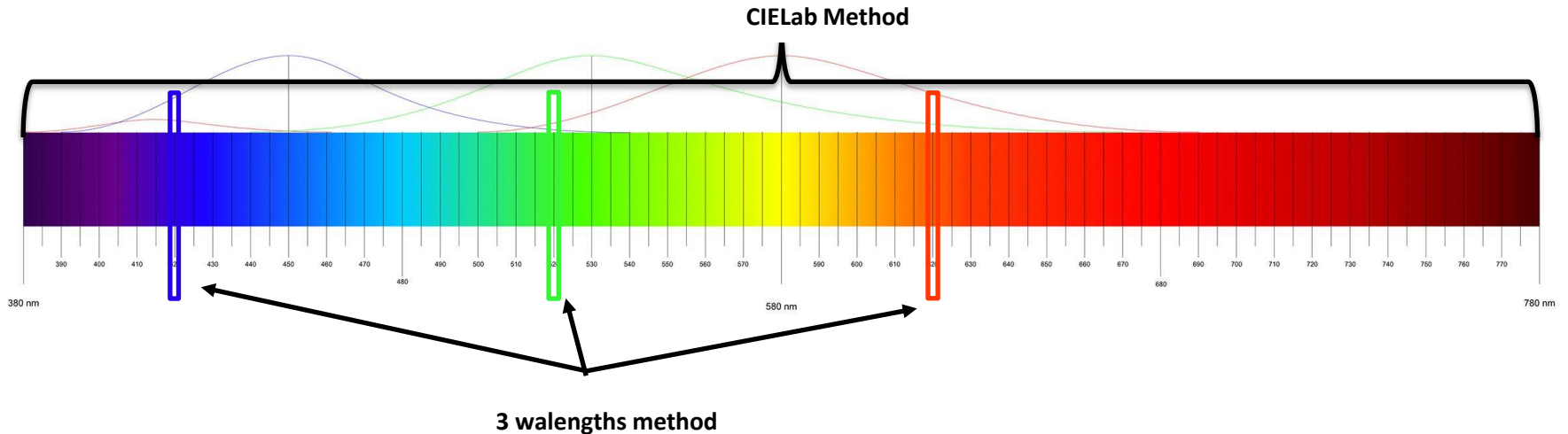
**SMART
ANALYSIS**

**The Smart & Portable lab
for QC in the winery**

CIE Lab vs. «standard» method

CIE Lab method plus:

- ✓ use of the entire *visible spectrum*
- ✓ color representation *closest to human vision*
- ✓ easily *represented graphically*
- ✓ the only one that allows to define the *color difference between samples*



➤ 3 Wavelentghs used in standard method: 420 – 520 – 620 nm

➤ 80 wavelentghs used in CIE Lab method: from 380 to 780 with 5nm steps



Pictures: <https://www.etslabs.com/library/37>
<https://www.etslabs.com/library/17>

Standard method

$$\text{Intensity} = A_{420} + A_{520} + A_{620}$$

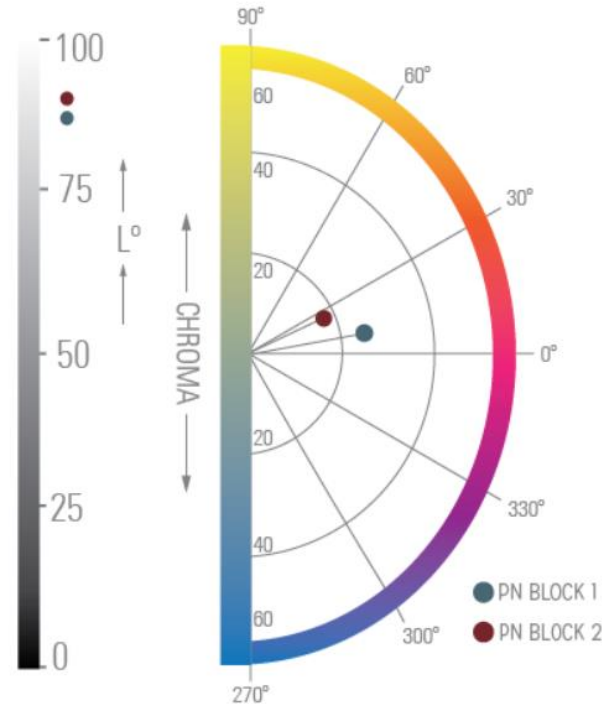
$$\text{Tone} = A_{420} / A_{520}$$

CIELab method

- L^* (degree of lightness)
- a^* (red (+) to green (-))
- b^* (yellow (+) to blue (-))

$$\text{Chroma} = (a^2 + b^2)^{1/2}$$

$$\text{Hue} = \arctan(b/a)$$



Color difference

$$dE_{ab} = \sqrt{(L_2 - L_1)^2 + (a_2 - a_1)^2 + (b_2 - b_1)^2}$$

International Organization of Vine and Wine (OIV) defines CIELab as the TYPE 1 reference method, which means that it acts as the only method for establishing the accepted value of the measured parameter.



CIELab is the only method that allows the winemaker to uniquely distinguish analytically and graphically the chromatic characteristics of wine, measuring the color differences between samples.

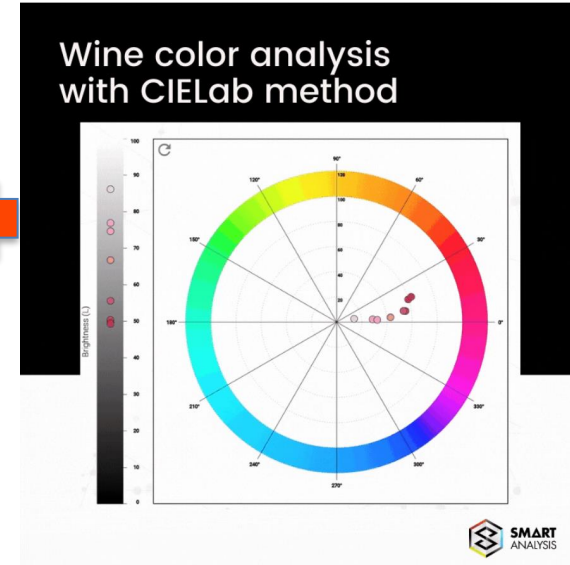
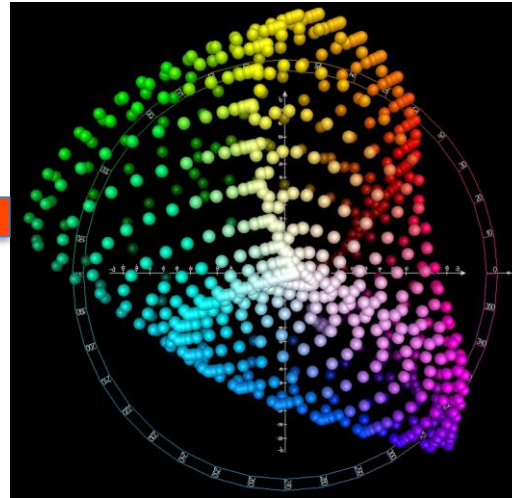
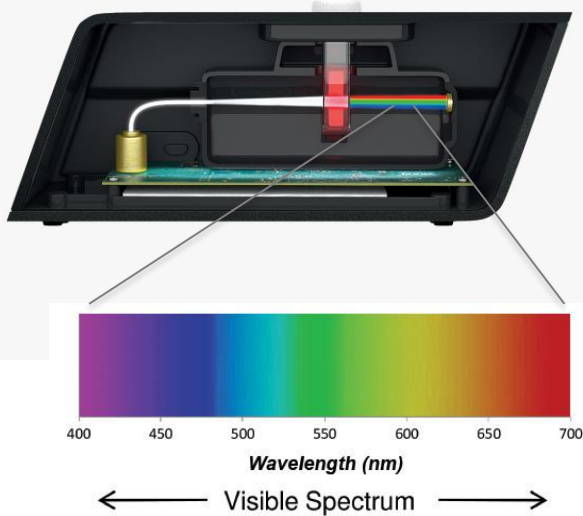
How to measure CIE Lab

Hardware

Technology

Software

User experience



The most difficult and challenging for a diagnostic tool!!



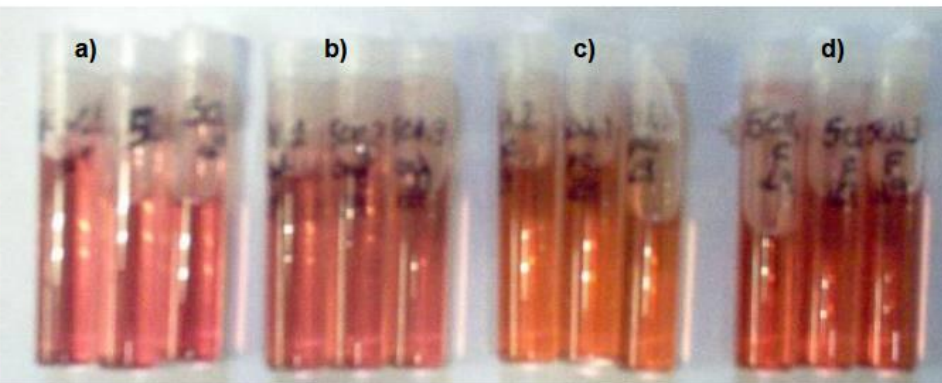
Optical technology (*PATENTED*)



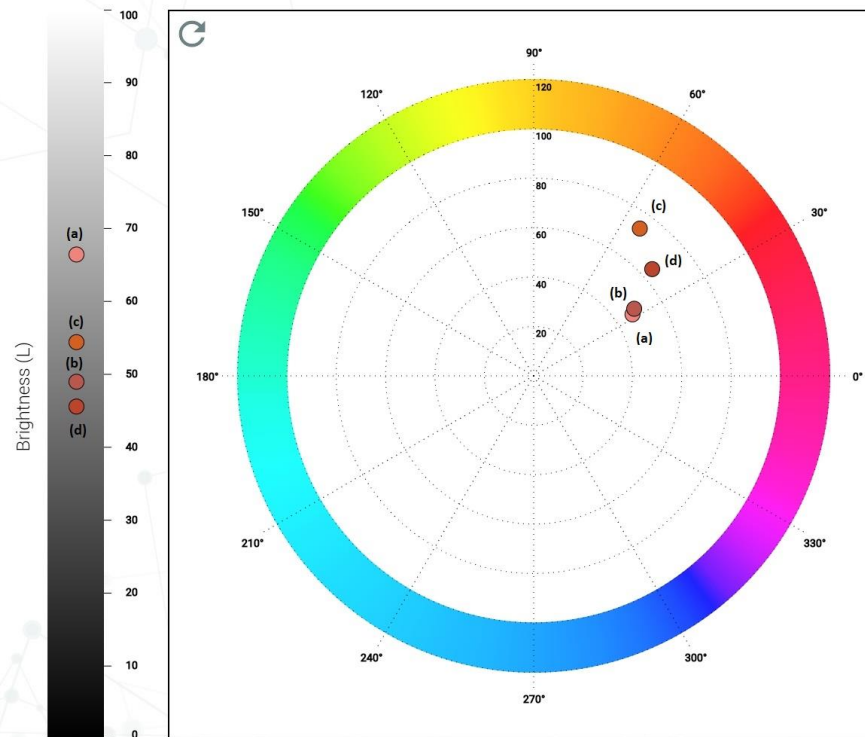
Complex algorithms to convert many data in the three 3-D color coordinates

- using an APP
- functional environment for winemakers
- plotting the results
- ...

Video CIE Lab with Smart Analysis:
<https://youtu.be/z9MG5o9lgtU>



Formation of vinylphenolic pyranoanthocyanins by selected yeasts fermenting red grape musts supplemented with hydroxycinnamic acids. *Int. J. Food Microbiol.* 2007, 116, 144-152. Morata, A.; González, M. C.; Suárez, J. A.



Last slide of the presentation by prof. Morata, which shows the chromatic effects on the same sample of wine treated with different yeasts.

Application: CIELab to choose the yeast that gives me desired color effects..



Alessandro Candiani
alessandro.candiani@dnaphone.it

Matteo Barozzi
matteo.barozzi@dnaphone.it

Lorenzo Niccoli
Lorenzo.niccoli@dnaphone.it

A photograph of a wine glass filled with red wine on a wooden surface. In the foreground, a miniature laboratory setup is visible inside a device. The setup includes a desk with a microscope, a stool, a cabinet with drawers, and a shelf with various laboratory glassware and equipment. The device has the 'SMART ANALYSIS' logo on its side.

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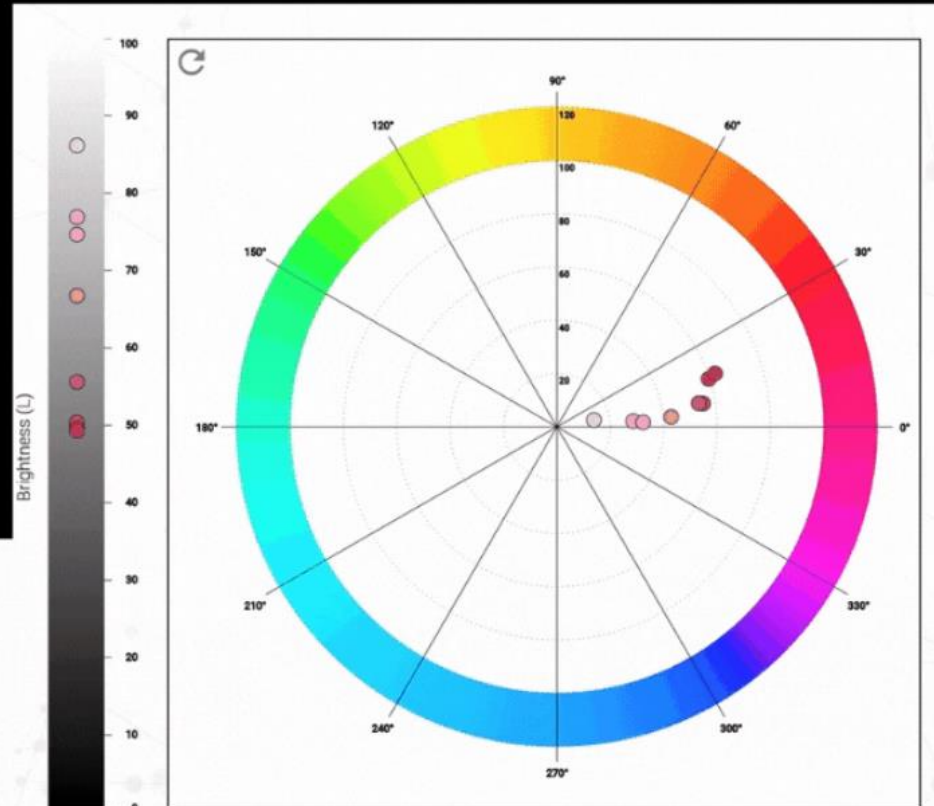
Main applications:

1- Color stability (to evaluate products & methods for wine finig)

2- Color control (on different production batches / vintages)

3- Evaluate differences between wines (to better correct them)

Wine color analysis with CIELab method

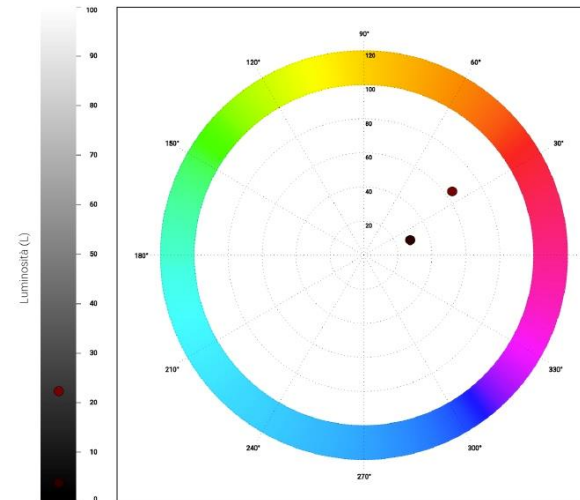
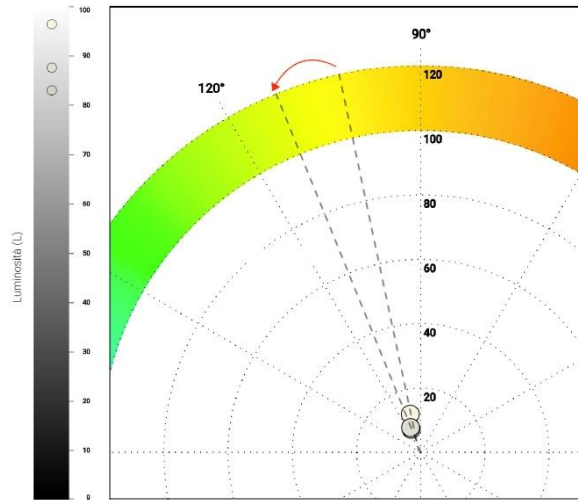


Sebastianelli (enologo consulente)

Applications

1- Chromatically stabilize the wine through wine clarification, choosing the best products

2- Check the color of the finished wine with the reference, for example the previous year's wine (for products sold abroad)



2- Filippo Giarola (consultant oenologist)

Application = Recovery of oxidized wines.

On wines oxidized during the redox procedure it is useful to evaluate how well the chosen products worked or not. Different brands or products are not guaranteed to have the same effect on wine, so CIELab helped him to evaluate the result and choose the most suitable or most efficient product for his needs.

3- Polinas (winemaker, winery owner).

Applications

1- Characterization / standardization of the color of a specific wine, chosen by a group of producers (objective: to sell a wine with the same chromatic characteristics within a producer association)

2- Color stability: measurement of D_{420} , an index that defines how many phenolic molecules are sensitive to SO_2 (in other words, to understand how much SO_2 to add without changing color in the wine)

4-Celestino Poser (consultant oenologist, external laboratory owner)

Applications

1- Characterization of the "rosé prosecco" color to determine an internal specification (protocol) within the consortium.

The characterization of the color until now has been done only sensorially.

Poser started the characterization using the CIELab. Once all the results of the wines analyzed have been acquired, they will observe the average color in the CIELab coordinates and the variation with respect to the reference. All the members of the consortium who wish to produce and market Prosecco Rosè must also respect these chromatic characteristics.

The advantage of CIELab is that, in addition to being the reference method of the OIV, it is the only one that allows to objectively define the color difference.

2- In the future Poser would like to apply cielab analysis in all those applications that have an impact on color: color stability vs SO2 quantity OR micro-oxygenation, wine fining, ecc..

Giotto consulting: analysis and consulting laboratory (Zoom interview)

Wine fining: process of elimination / reduction of substances to avoid problems.

Eg, reduction of polyphenols, tartaric stabilization, protein stabilization, oxidation management..

Why they use CIELab: "because with the total spectrum I have much more information, I can reconstruct the color, I see which trajectory the color is taking, I can measure the color difference between two samples or between a sample and a reference. In this way they have an objective and complete measure. This is the analytical method chosen by Giotto for the study and for their advice in the field of oxidation because it can also be used in the cellar. The other methods / tests found in the literature are all tests that are good for research but are neither simple nor practical (eg linear cyclic voltammetry, DPPH, etc..).

Tip 1. During the wine fining procedure, in addition to the color measurement, an important measure is the variation of IPT%, that is, how much the IPT have dropped after wine fining compared to the initial value. This is always to evaluate the products Understanding the product / process that works best means saving money.

Tip 2. The identity of the wines is much more important than the concept of generic quality. All the operations of wine fining, micro-oxygenation, etc., are "subtractive" operations, therefore they also have an impact on the organoleptic sensations. As a lab they try to work synergistically, that is, they try solutions to avoid oxidation using products that are already present in the wine (eg particular yeasts).

Where they use cielab:

oxidation: they apply protocols to estimate the duration of wine and resistance to oxidation. All measurements are made with CIELab. Based on the cielab values, they also decide how to act.

Giotto consulting: analysis and consulting laboratory

Pinking and browning: phenomena that are still “little” known (especially pinking). Browning is much better known. These are effects that cause a tendency to turn towards the pink or “dark” yellow of white wines. They say they occur in particular vintages and in particular areas (a lot for example in the East.) And more with some vines than with others. They have a procedure that allows them to measure resistance to these effects.