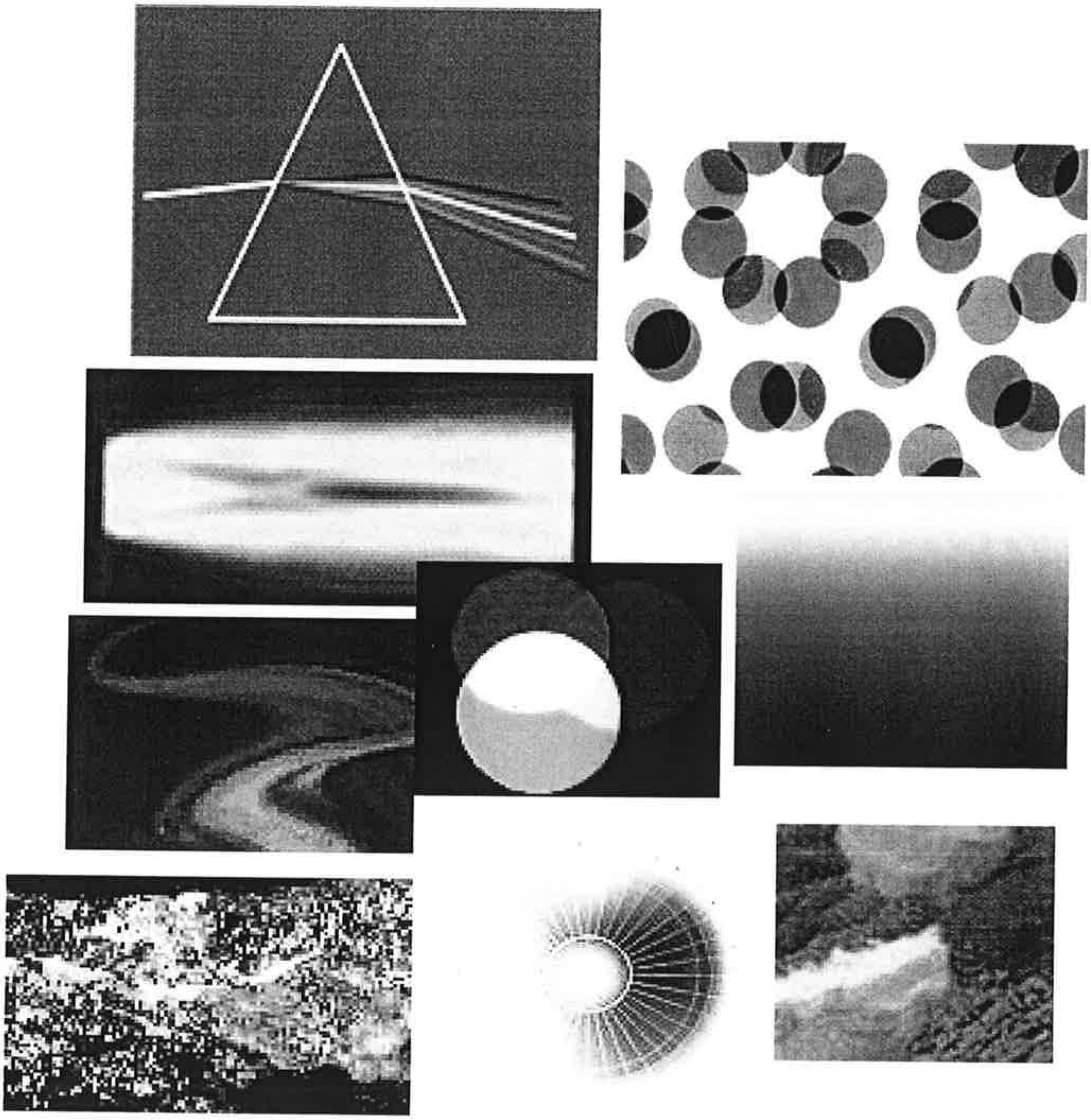
CIENCIA Y TECNOLOGÍA DEL COLOR

2008 WORKSHOP ON

"COLORIMETRY AND COLOR IMAGING"



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Color in virgin-olive-oil tasting glasses

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ABSTRACT:

Color measurements of 18 virgin-olive-oil tasting glasses and 10 different virgin olive oils, in a color cabinet with a D65 source. These measures were made using a spectroradiometer with geometries tilted at 0°, 30°, and 60°, simulating different positions of the taster's eye. None of the cups employed had all their geometrical dimensions within the standardized values, despite being cups used in official sensorial analyses. Comparing color variability of the oils in different tasting cups we discovered that in all the color differences the average color difference was above visual threshold.

Keywords: Virgin olive oil, oil tasting, color measurement, color differences, standard oil-tasting cups, MCDM.

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1. Introduction

Color is not considered in virgin-olive-oil sensorial analyses, but it is recognized as an important organoleptic property influencing consumer's preferences and subsequent choices. Therefore different color-specification techniques for virgin olive oils have been reported in the literature. Thus, a visual comparison between the color of a given oil sample and a two-dimensional scale with 60 fixed solutions, called bromthymol blue (BTB) scale, has been suggested[1]. The BTB standards were correlated with CIELAB color coordinates[2], because currently CIELAB is one of the two internationally proposed spaces for color specification[3]. The limited precision and accuracy achievable from the BTB standards[4] led to the proposal of an alternative theoretical scale, named Uniform Oil Color Scale (UOCS), with improved performance upon BTB method[5]. Color specification of virgin olive oils from spectrophotometric and spectroradiometric measurements have also been proposed, showing the lack of good correlation between these two techniques[6]. Following our previous research on color of virgin olive oils, this paper focuses on the color of standard virgin-olive-oil tasting cups, analyzing whether they really conceal the color of commercial virgin-olive-oil samples. From the results, we provide information on the standard cups currently employed in official virgin-olive-oil tasting[7], seeking to improve virgin-olive-oil sensorial analyses.

2. Materials and Methods

We have collected 18 blue-tinted standard cups for virgin olive oils, employed by experts at different laboratories of the "Instituto de la Grasa" (National Research Council, Seville, Spain). A vernier caliper, with sensitivity ± 0.05 mm, was used to measure the different dimensions of each standard cup, and a glass-graduated cylinder, with a sensitivity of ± 2.0 ml, to measure their capacity.

10 commercial extra-virgin olive oils produced in Spain were selected, which might be considered representative of the extra-virgin olive oils found by consumers in the marketplace. The spectral transmittances of samples of these 10 oils were measured with a JASCO-V650 spectrophotometer (Jasco Europe S.R.L., Cremella, Italy), using a 5.0 mm path-length cell, and their corresponding CIELAB color coordinates were computed, assuming the D65 illuminant and CIE 1964 Supplementary Standard Observer.

We poured 200 ml of oil in each standard cup, and located the cup in a fixed position on the floor of a GretagMacbeth Spectralight III color cabinet equipped with a daylight source which simulates the CIE D65 illuminant quite well[8]. Spectral radiant powers were measured using a SpectraScan PR704 (Photoresearch Inc., Chatsworth, CA, USA) spectroradiometer. The spectroradiometer was positioned in front of the color cabinet on a sturdy tripod that allowed both vertical movements and three different tilts of the optical axis of the spectroradiometer: 0°, 30°, and 60° (see Figure 1). These different positions of the spectroradiometer may be considered representative of the ones occupied by the taster's eyes performing sensorial analyses in a cabinet. The spectroradiometer performed spectral power measurements in the range 380 to 780 nm at 2 nm steps, using a measurement field of 1°. The CIE 1964 Supplementary Standard Observer[3] was assumed in all our computation.

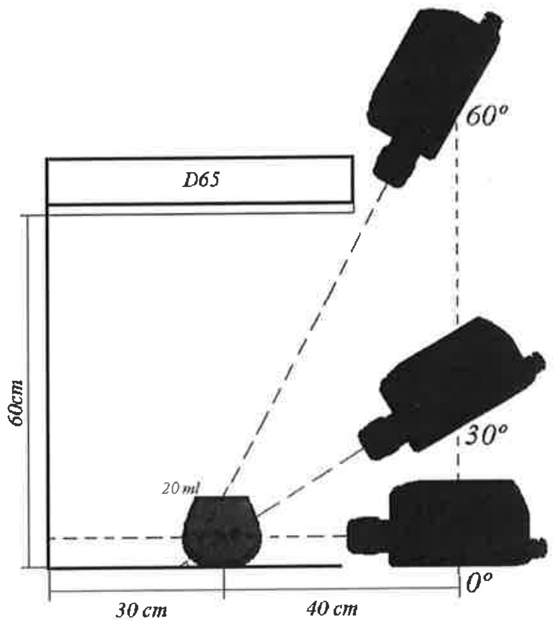

Fig.1. Scheme of the setup for spectroradiometric measurements.

3. Results and discussion

For each geometry (0°, 30°, and 60°) we have obtained a total of 13,770 CIELAB color differences, the result of considering all the combinations by pairs of the 18 available tasting cups (153 pairs) and the 10 virgin olive oils (45 pairs), multiplied by 2 because we must distinguish, for example, the case of oil 1 in cup 1 versus oil 2 in cup 2, from the case of oil 1 in cup 2 versus oil 2 in cup 1.

Figure 2 shows the percentage of color pairs with CIELAB color differences in different intervals, and in the different geometries of 0°, 30°, and 60°. For the 0° geometry the percentage of color pairs with CIELAB color differences in the interval 0-2 CIELAB units is close to 50%, while this percentage is considerably lower (around 15%) for the 30° and 60° geometries. A large percentage of small color differences (< 2 CIELAB units) can be found for two tasting cups with different oils when the visual observation is made in a horizontal direction. This percentage of small color differences is lower than for 30° or 60° visualization. A very high number of pairs with clearly perceptible color differences (> 2.0 CIELAB units): specifically, more than 50% of the total pairs for the 0 ° geometry and more than 85% of the total pairs for the 30 ° and 60 ° geometries. There also are pairs with very strong color differences (>15 CIELAB units).

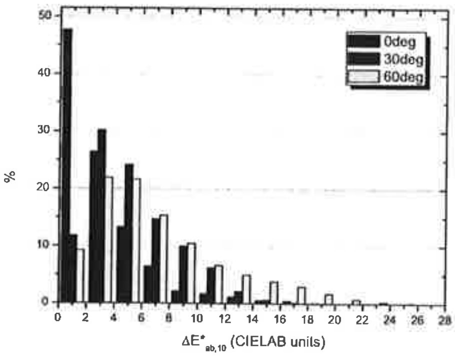

Fig.2. Histogram of CIELAB color differences measured by a combination of all potential color pairs from 18 tasting cups and 10 virgin olive oils, distinguishing the three measurement geometries (0°, 30, and 60°).
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Table I shows the average CIELAB color difference $\overline{\left(\Delta E^*_{ab}\right)}_{i,j}$ and standard deviation (SD) found with the 13,770 color pairs possible from our 18 oil-tasting cups and 10 virgin olive oils. In agreement with previous results, Table 4 shows that the lowest average color differences and standard deviations correspond to the 0° geometry, with values clearly greater than the human visual threshold. In any case, it must be said that, as expected, the use of blue-tinted glasses in oil-tasting cups reduces the perceived color differences between different olive oils: for example, in a previous work[6] we found that when transparent Pyrex glasses with 46.4 mm thickness were used, the average color differences from the 10 oils considered here was 10.96 CIELAB units, with a standard deviation of 7.23 CIELAB units (clearly higher than those shown in Table 4).

TABLE I
Average CIELAB color difference and standard deviation (SD) computed from the 13,770 color pairs obtainable from our 18 olive-oil tasting cups and 10 virgin-olive oils, considering each one of the 3 measurement geometries.

Angle	$\Delta E_{ab,10}$	SD
0°	3,07	2,87
30°	5,25	3,07
60°	6,89	4,59

4. Conclusion

The instrumentally measured color-differences in this work are greater than typical human visual thresholds in many cases. It would be reasonable in virgin-olive-oil sensorial analyses to propose the use of opaque tasting cups made with black material. In this way it would be possible to completely avoid the influence of color on the tasters'.

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