

OLIVE RIPENING ASSESSMENT METHODOLOGIES USING DIGITAL IMAGE ANALYSIS

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Introduction

Analysing the colour of fruits, especially olives, is one of the most basic steps for the evaluation of their ripening and, therefore, to decide when to collect them. Traditionally, this assessment is carried out by experts by determining the colour of each olive on a reference scale and then calculating a global Maturity Index (MI) of the tree/field [1]. Instead, using digital image analysis can be a more objective way to make a quantitative evaluation of the ripeness of olives and other fruits, as colour and ripeness are directly related and only one image of a representative number of olives is needed [2].

Aim of study

- Developing a new, fast and easy way of assessing the ripening of olives.
- Comparing the results when using different chemometric tools.

Materials and Methods

Samples

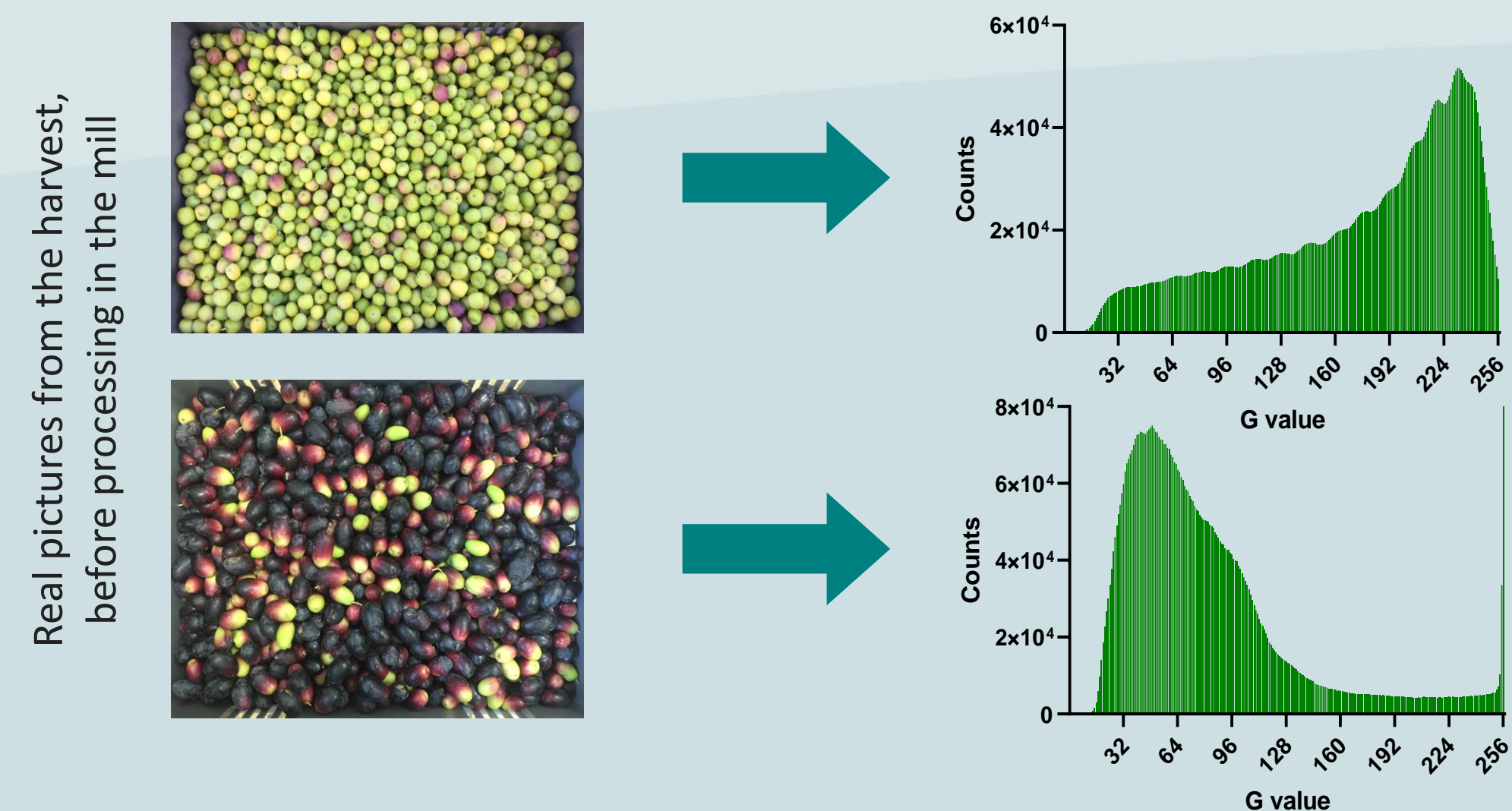
- **7 olive varieties**
Arbequina, Coratina, Corbella, Empeltre, Koroneiki, Morrut & Picual.
- **3 ripening stages** (low, medium & high)

Analysis

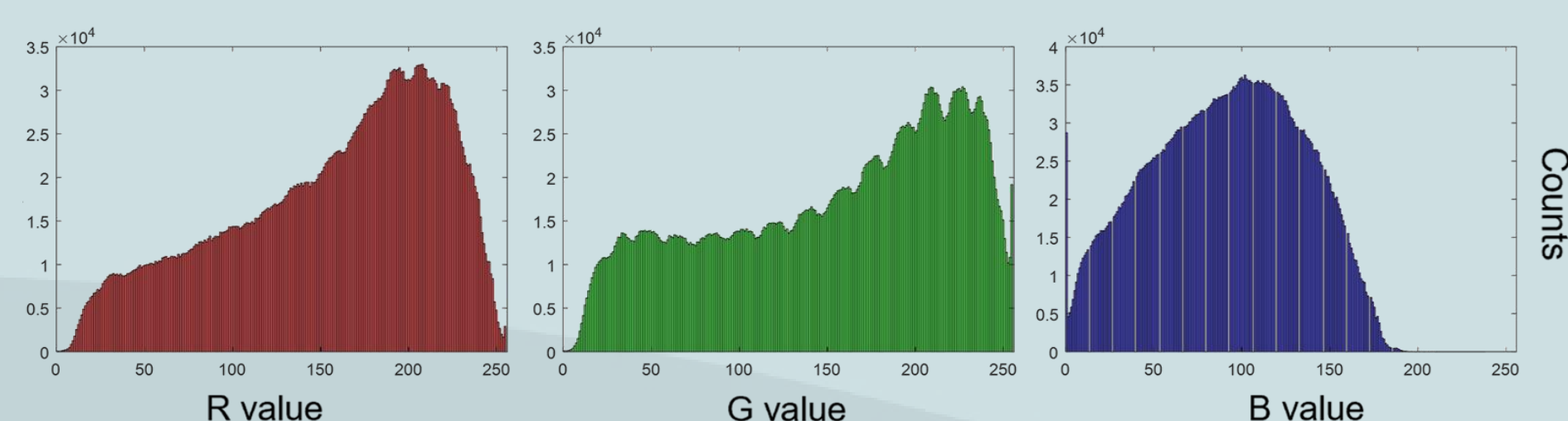
- **MI** determined by experts (using 50 olives) [1]
- **Cellphone picture** (iPhone 6 plus)



These peaks evolve as the olives ripen; the dark peak gets higher as the light one gets lower, resembling the spectra of one species reacting into another, specially in the Green channel. So, the histograms can be used to evaluate the ripening of imaged olives [3].



As digital images are based on the decomposition of the colour of each pixel into a 3D space, RGB (Red, Green and Blue), these values can be statistically treated.

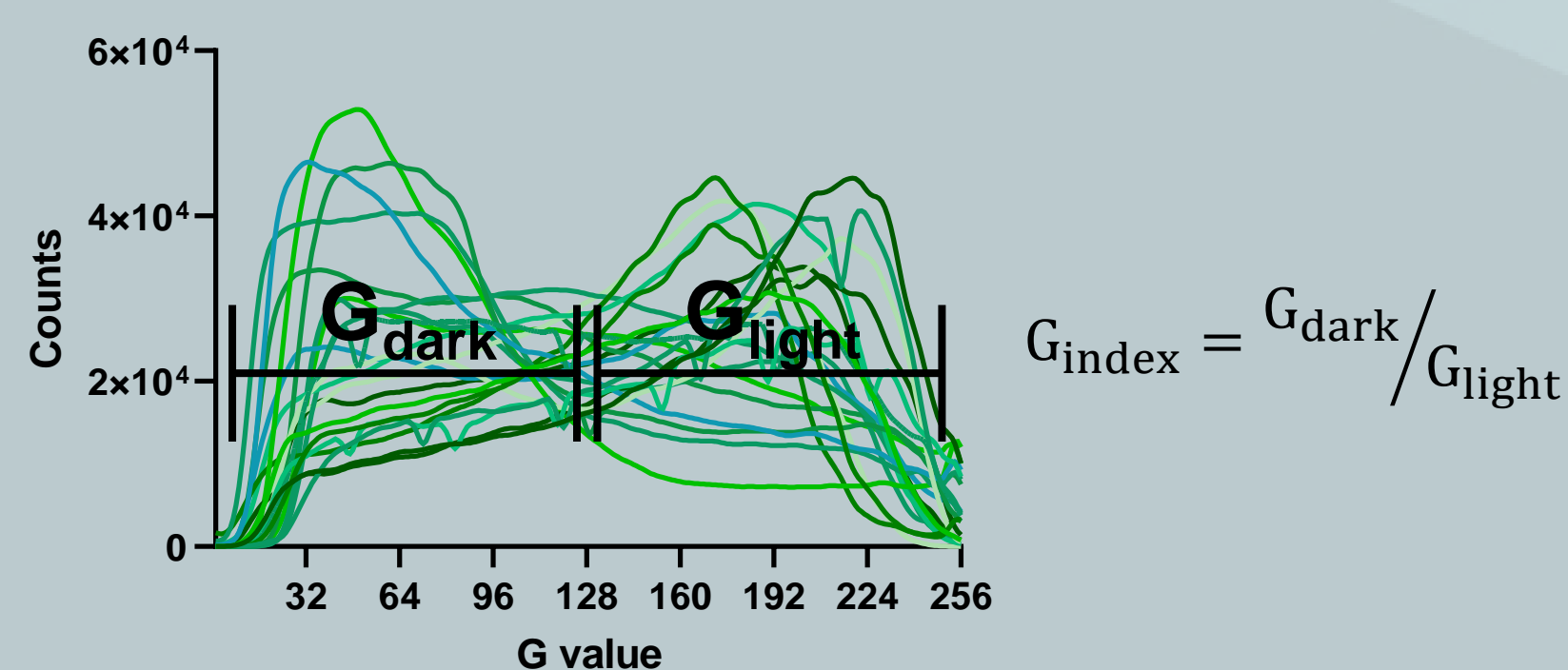


The histograms of the pictures behave as spectra, with two main peaks: one in the lower values (dark pixels) and another one in the higher values (light pixels).

Software: MATLAB, PLS toolbox (Eigenvector) results 2 and 3 and MCR toolbox [4] result 4

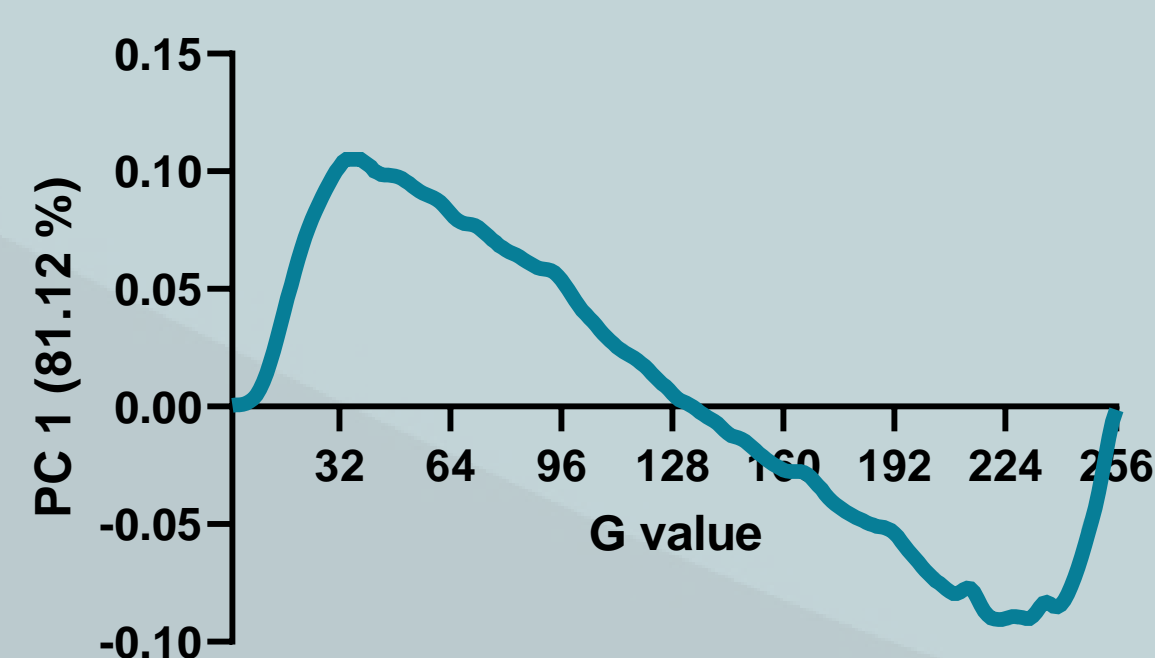
Results

1) Univariate analysis: Average values



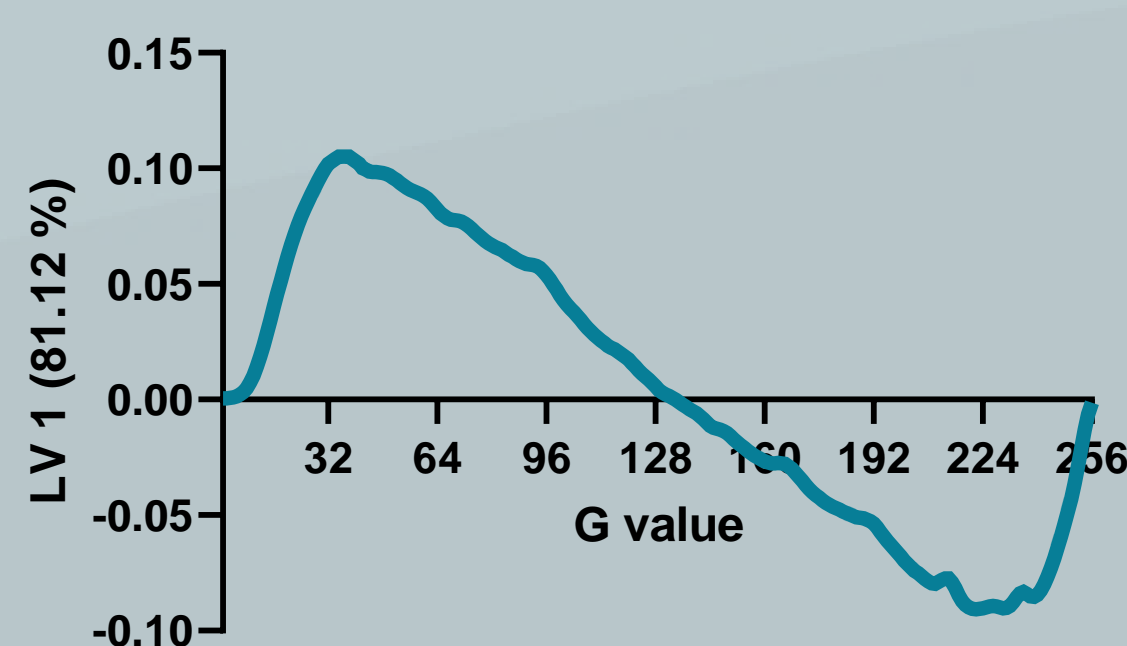
Averaging the values in each half of the histogram and calculating their ratio offers a value that is proportional to the MI: the G_{index} so it can be used to build a regression line for prediction.

2) PCR



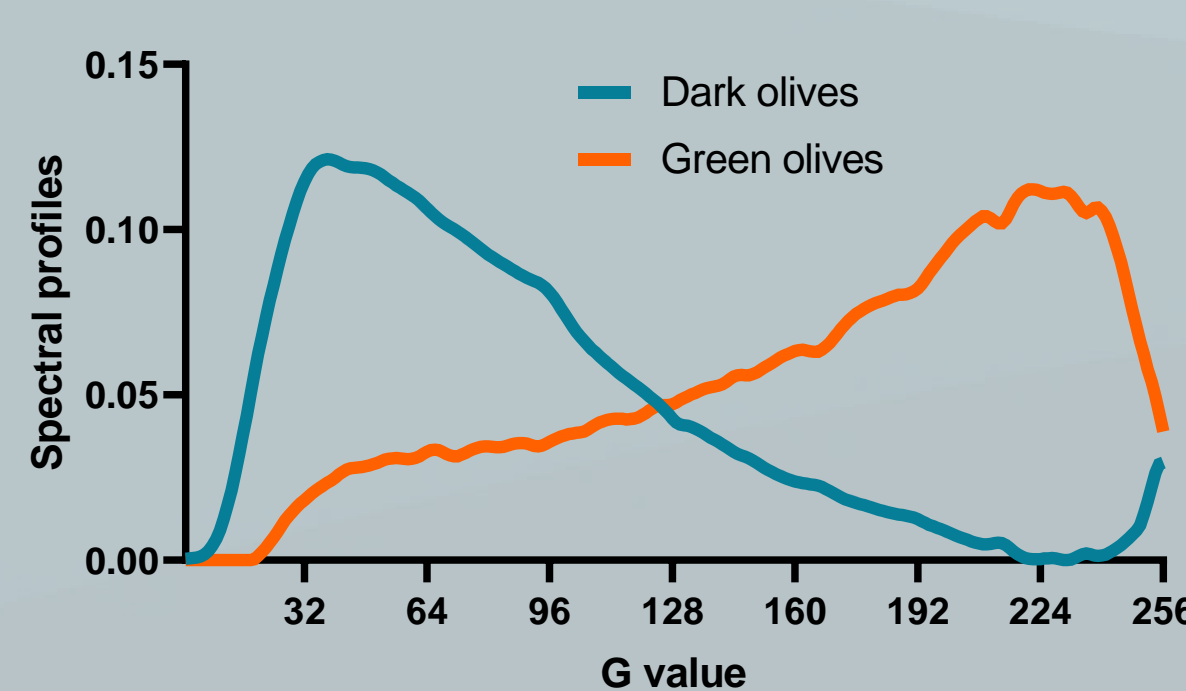
When PCR is applied to the histogram only one Principal Component is needed in order to correlate its scores with the MI and predict them.

3) PLSR



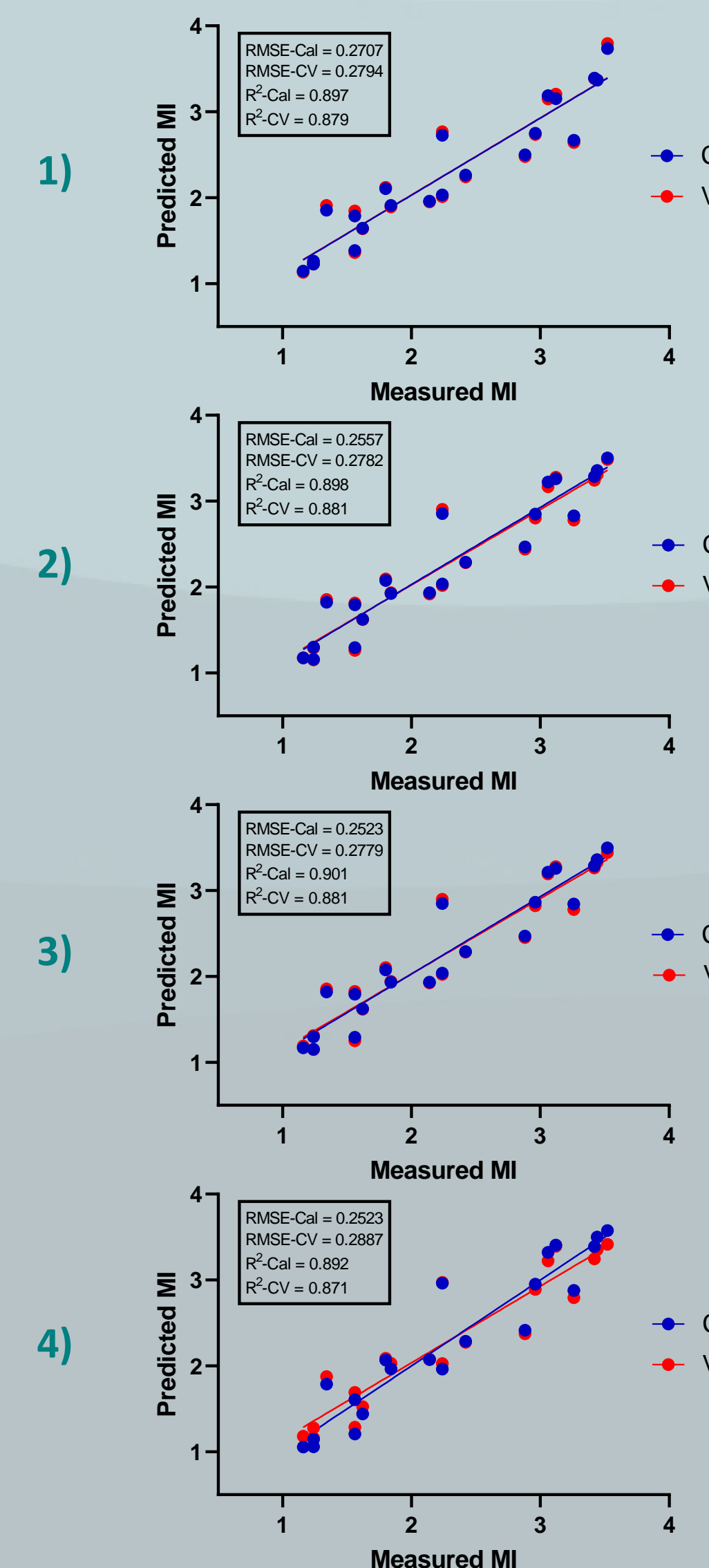
Applying PLS can directly correlate the histograms of the pictures with their MI. The same result as with PCR is obtained, as the main variability source is related to maturity.

4) MCR-ALS



MCR-ALS can easily separate the mentioned peaks: dark olives and green olives, the proportion of dark ones being correlated to the MI. So, a regression model can be built with their concentration profiles.

MI prediction models performance



Conclusions

- Olive ripening can be assessed in a fast, cheap and reliable way using regular cell phone image analysis. This offers an illustrative estimation of when the olives can be collected without the need of an exhaustive analysis.
- All the methods provide similar results, showing that when the information of interest is related to the main source of measurements variability this information can be easily obtained with different chemometric tools.



Bibliography

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