

## CHEMOMETRICS AND THE MEDIEVAL SCRIPTORIUM

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Chemometrics can be defined as the science that relates measurements from a chemical system or process with the system state through the application of mathematical or statistical methods. The application of chemometrics for analyzing multidimensional data has been growing and is especially used in the different areas of analytical chemistry and chemical engineering. This communication presents a survey on the applicability of chemometrics tools in the context of conservation and restoration here focused in the Portuguese medieval illumination artistic field. The ability of chemometrics to unveil multivariate hidden patterns combined with the growing availability of high-throughput monitoring analytical equipment makes it a fundamental tool for conservation and restoration research and development applications. In this communication different chemometrics techniques were applied to the analysis of greens and other colours (e.g., red and blue) used for the production of illuminations in the Lervão monastery (Coimbra, Portugal). Samples have been studied in the framework of an interdisciplinary project "The colour of Portuguese medieval illumination: an interdisciplinary approach". In this research chemometrics analyses were used to fingerprint the specificities of the colours used in Portuguese medieval illuminations, namely if they could be infrared spectroscopy (FTIR) data collected from micro-samples of XII century Portuguese medieval illuminations. The main objective of this study was to unveil the utilization and proportion of utilization of organic binders in the painting procedure. Chemometrics techniques for qualitative and quantitative analysis were described. For example, principal components analysis (PCA) was applied to FTIR data between 2800 and 3000  $\text{cm}^{-1}$ , a region less vulnerable to unwanted spectral variations. In the analysis, FTIR spectra of sample binders (egg white, parchment glue and egg yolk) and calcium carbonate, an extender found in many reds, were used as references. In order to analyse deeply the composition of the binder and to estimate the painting recipe a multivariate curve resolution (MCR) method (quantitative method) was applied to red samples spectra. The MCR algorithm attempts at resolve the spectra in its pure components. The analysis was performed in the same range and standard normal variate was used as spectra processing. This method was able to resolve the FTIR spectra of illuminations micro-samples and produce an estimation of pure organic compounds possibly used as binders during the illuminations production. Resemblance between the unveiled spectra and the actual spectra of potentially used binders allowed some conclusions to be taken.

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