Direct fluorimetric characterization of dyes in ancient purple codices

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Purple codices are manuscripts written in silver and golden inks on purple-coloured parchments produced from the Late Antiquity to the Middle Ages to be owned by Kings or Emperors. Only a few examples of these amazing works of art still survive in libraries or archives. The identification of the purple dyes employed to colour purple codices is an intriguing task, as sampling is seldom permitted on these precious manuscripts and thus scientists should rely only on *in situ* analytical techniques. Nevertheless, non-invasive procedures show both strong and weak points. In particular, when natural dyes are considered, the obtained information may in some cases be unsatisfactory in order to achieve a thorough characterisation of the dyes [1-3]. For this reason, micro-invasive techniques are still widely employed when the presence of natural dyes is hypothesised in an artwork [4-5].

The exceptional availability of a small sample from the 6th century *Codex Brixianus*, conserved at Biblioteca Civica Queriniana (Brescia, Italy), allowed us to perform an in-depth fluorimetric survey of the purple parchment of this artwork. This manuscript has been previously investigated by means of non-invasive techniques (portable X-Ray Fluorescence spectrometry, UV-visible diffuse reflectance spectrophotometry with optic fibers and portable fluorimetry) which suggested that orchil or folium are most probably present in the parchment [6].

In this work, *in situ* fluorimetric measurements widened the previous analyses on the manuscript and suggested the contextual presence of both folium and orchil in some pages. In addition, emission fluorescence and luminescence lifetime measurements were performed on the sample from *Codex Brixianus* and on a set of reference parchments dyed with folium, orchil or a mixture of these two dyes. These measurements confirmed and narrowed the results obtained with *in situ* fluorimetry, thus opening the discussion about the peculiar manufacturing technique of this purple codex.

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