



Big Data from Tiny Samples: unveiling the use of organic materials in the Visconti-Sforza *tarocchi* decks

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Scientists, conservators, curators and a deck of cards. This grouping sounds like a fun Friday night, but is actually the composition of a multi-institutional collaborative research project into three mid-15th century decks of Italian *tarocchi* cards, known as the Visconti-Sforza decks. The decks are painted on pasteboards with a colorful palette, translucent glazes and gilded backgrounds. Despite wide interest in the decks at their five holding institutions in the United States and Italy, there was a dearth of technical data about the nature of their materials and construction. An extensive scientific study was started to cover the gap in knowledge about the decks. The study first focused on the identification of pigments and colorants used in the paint layers by means of non-invasive techniques. A second focus on organic binders and translucent glazes was possible through the removal of micro samples. The nature of binders and glazes often remains an open question for artworks on paper supports due to the difficulty of taking samples or due to the limited amount of sample available when sampling is allowed. However, knowing the nature of these organic materials is critical to understanding the creation of the cards, as well as to inform conservation treatments and exhibition decision making.

This study aims at increasing the awareness that questions about the precise nature of the organic materials can now be explored and often answered, even when starting with a limited amount of sample. While not all institutions have access to these analytical techniques, know-how and funding, collaboration becomes key to deepen the understanding of valuable works of art. In the past couple of decades, mass spectrometry-based analytical techniques, such as proteomics and glycomics, have been increasingly applied to the study of micro-samples from art and archaeological artefacts. These analytical strategies are capable of providing the precise composition and origin of biological materials, and the constantly improving level of sensitivity, makes them the best candidate for the investigation of micro and complex cultural heritage samples. In this study, shotgun (bottom-up) proteomics using liquid chromatography tandem mass spectrometry (LC-MS/MS), matrix assisted laser desorption ionization mass spectrometry (MALDI-MS) using partial enzymatic digestion, together with pyrolysis gas chromatography mass spectrometry (Py-GCMS), revealed the nature of the paint binder and glazes of the *tarocchi* cards, opening a new path for interpretation of materials choices and comparison of the different decks of cards.

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