

Polyphenolic characterization of iron-gall inks through the use of historically accurate reconstructions

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Abstract

Degradation of manuscripts catalyzed by iron-gall inks is a major conservation issue in heritage collections, posing a serious threat to world written heritage. In Europe, iron-gall ink recipes are profusely described in medieval treatises that mention the use of plant extracts such as *Quercus infectoria* that were combined with iron salts. For the past 30 years conservation and restoration treatments were based on the proposed structure of the inks being an iron-gallate complex [1]. However, more recently, an interdisciplinary team gathering experts from the conservation sciences, chemistry and experimental archaeology have proven this model to be an oversimplification. This research is carried out within the project "Polyphenols in Art: chemistry and biology hand in hand with conservation of cultural heritage".

Together with the Universidad de Córdoba we have prepared medieval inks using ingredients and methods appropriate to the 15th – 17th centuries. The five historical inks studied were selected based upon research into Iberian written sources of medieval techniques [2]. These inks were then further studied in collaboration with experts in complex polyphenol systems, in Porto University; we could uncover by HPLC–ESI–MS that the extracts from the galls are far more complex than what has been considered in the heritage community. In fact, gallic acid is found as a minor compound, when compared with the galloyl esters of glucose. Raman and infrared spectroscopies have also shown that medieval writing inks could not have been represented solely by iron complexes with gallic acid and that a far more complex structure is yet to be uncovered. The next step is the understanding of the degradation pathways of these historical reconstructions so that new conservations treatments can be developed and tested.

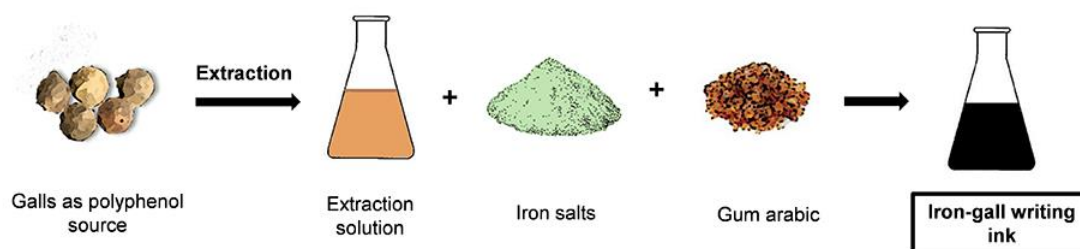


Figure 1. Main steps and ingredients in the production of a medieval iron-gall ink.

References

- [1] A. Ponce *et al.*, *Anal Chem.* (2016) 88, 5152–8.
- [2] R.J. Díaz Hidalgo *et al.*, *Heritage Science* (2018) 6.

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