

Culture

Study of five iberian medieval iron-gall inks obtained through the use of historically accurate reconstructions

Natércia Teixeira,^a Alexandra Silva,^a Catarina Henriques,^a Filipa Campos,^a Inês Costa,^a Nuno Mateus,^a Fernando Pina,^b Maria João Melo,^b Victor de Freitas^a

a) LAQV-REQUIMTE, Departamento de Química e Bioquímica, Faculdade de Ciências, Universidade do Porto, Rua do Campo Alegre, s/n, 4169-007 Porto, Portugal; b) Department of Conservation and Restoration and LAQV-REQUIMTE, Faculty of Sciences and Technology, Universidade NOVA de Lisboa, 2829-516 Monte da Caparica, Portugal

Email: natercia.teixeira@fc.up.pt

Iron gall ink is one of the most important inks in the history of western civilization, and it was in widespread use from the middle ages until the beginning of the 20th century. The degradation of manuscripts catalyzed by iron-gall inks is a major conservation issue and a serious threat to the world written heritage¹.

We have prepared five medieval inks using the same ingredients and similar methodologies. They are the result of research on Iberian written sources of medieval techniques and contained three basic ingredients (**Figure 1**): Fe²⁺ obtained from an iron sulphate salt, a phenolic extract (tannins), and gum arabic^{1,2}. Different additives, such as other metal ions and pigments, and different extraction conditions were applied. These variations of different additives were studied and its contribution to the specific ink recipe was revealed³.

All the extracts and inks were analyzed in threefold by HPLC-ESI-MS and HPLC-DAD. HPLC-ESI-MS allowed the identification of the phenolic compounds present both in extracts and inks. HPLC-DAD allowed the quantification of these compounds³.

The main goals of this work were: 1) to identify and quantify the major phenolic compounds present in the gall extracts and evaluate its variation by the addition of an iron sulphate salt and gum arabic when producing the iron-gall inks; 2) to identify and quantify the effect of each additive on each tested recipe.

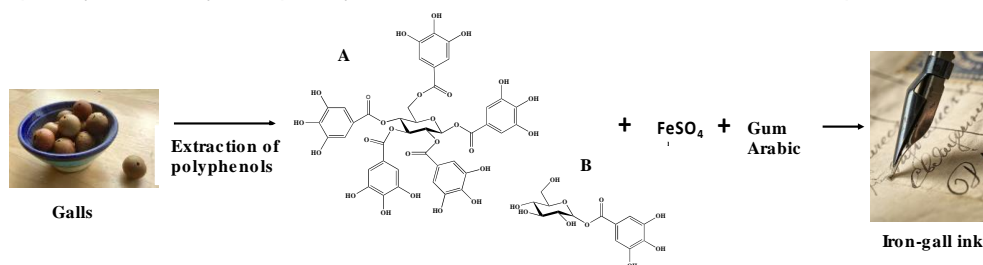


Figure 1: Basic recipe for an iron-gall ink. A: pentagalloylglucose; B: monogalloylglucose

Acknowledgements: We thank the Fundação para a Ciência e Tecnologia for financial support: FCT/MCTES project PTDC/QUI-OUT/29925/2017 for the contract REQUIMTE/EEC2018/PTDC/QUI-OUT/29925/2017 and UID/QUI/50006/2019 with funding from FCT/MCTES through national funds.

References:

1. Neevel H. In: Kolar J.; Strlič M., editors. *Ljubljana: National and University Library*, **2006**, 147-172.
2. Zerdoun-Bat Yehounda M., *Les encres noires au Moyen Âge (jusqu'à 1600)*. 1st ed. Paris: *CNRS Éditions*, **2003**.
3. Díaz Hidalgo, R.J.; Córdoba, R.; Nabais, P.; Silva, V.; Melo, M.J.; Pina, F.; Teixeira, N.; Freitas, V. *Heritage Science*, **2018**, 6(1), 63.