

## Enlightening the phenolic compounds present in iron-gall inks obtained through the use of historically accurate reconstructions

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### Abstract (max 500 words including references)

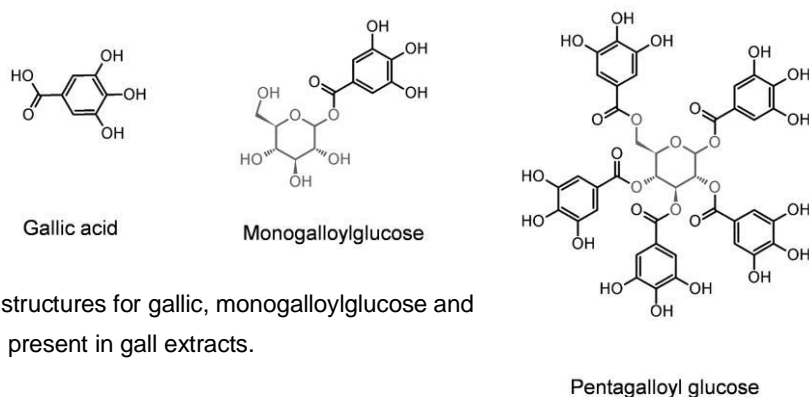
The degradation of manuscripts catalyzed by iron-gall inks is a major conservation issue and a serious threat to the world written heritage. These iron gall inks have been described as complexes of gallic acid or tannic acid, available in gall extracts, with iron ions [1].

To assess this hypothesis, we have prepared medieval inks using the same ingredients and similar methodologies. The five historical inks that were studied are the result of research on Iberian written sources of medieval techniques and contained three basic ingredients: Fe<sup>2+</sup> 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.

All the extracts and inks were prepared in fivefold and analyzed by HPLC-ESI-MS and HPLC-DAD [3]. HPLC-ESI-MS allowed the identification of the phenolic compounds present both in extracts and inks. HPLC-DAD allowed the quantification of these compounds.

The main goal of this work was 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.

The analyses showed that the relative concentration of gallic acid and its glycosylated derivatives varies considerably with each recipe. In fact, in some cases, polygalloyl esters of glucose are present as major compounds (Figure 1).



**Figure 1.** Molecular structures for gallic, monogalloylglucose and pentagalloylglucose, present in gall extracts.

These observations lead us to conclude that, so far, it seems that the chemical structures of the complexes present in iron gall inks are best described as mixtures of iron-polygalloyl and iron-gallate complexes.

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