Inks of papyrus, inks for papyrus: recipes from the Arabic world

Claudia Colini*
Bundesanstalt für Materialforschung und –prüfung, Berlin
Cluster of Excellence Understanding Written Artefacts, Universität Hamburg
claudia.colini@bam.de

Abstract

The term «papyrus» appears in ink recipes from the Arabic world as either a writing support or a material to be recycled into charcoal. This paper offers an overview of ink recipes, their context and transmission in order to evaluate the mention of «papyrus». The types of ink identified as those prepared for papyrus will also be compared to the types prepared for paper and parchment.

Keywords

Arabic ink recipes, writing support, materiality

Ink recipes appear in a wide host of Arabic texts, from treatises about magic and astrology, to collections of *mirabilia* and encyclopaedias, to technical handbooks for secretaries and calligraphers or even street artists, performers or tricksters. In some cases, they can even be found in lists or as single entries associated with unrelated works. However, the main sources of ink recipes are treatises and handbooks dealing with book production. The five most important works of this category, and therefore the texts that have been studied in detail, are:

- *Zīnat al-kataba* by Abū Bakr Muḥammad b. Zakariyyāʾ al-Rāzī, (d. 925 or 935 A.D.);[2]
- *ʿUmdat al-kuttāb wa-ʿuddat ḏawī al-albāb* by al-Muʿizz b. Bādīs al-Tamīmī al-Ṣanhāǧī (d. 1062 A.D.);[3]

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[2] Goodman, E. L., "al-Rāzī" in *EI*, II online [http://dx-1doi-1org-1003c45yj604e.emedien3.sub.uni-hamburg.de/10.1163/1573-3912_islam_SIM_6267] (accessed 06 March 2019); Brockelmann 1898, 233-235; Brockelmann, 1937, 417-421; Zaki 2011.

[3] Talbi (accessed 06 March 2019); Brockelmann 1898, 268; Brockelmann 1937, 473; ibn Bādīs 1988.

- *al-Muḫtaraʿ fī funūn min al-ṣunaʿ* by al-Malik al-Muẓaffar Šams al-Dīn Yūsuf b. ʿUmar al-Ġassānī (d. 1294-1295 A.D.);[4]
- *Kitāb al-azhār fī ʿamal al-aḥbār* by Muḥammad b. Maymūn b. ʿImrān al-Marrākušī al-Ḥimyarī (13th cent. A.D.);[5] and
- *Tuḥaf al-ḫawāṣṣ fī turaf al-ḫawāṣṣ* by Abū Bakr Muḥammad b. Muḥammad al-Qalalūsī al-Andalusī (d. 1308 A.D.).[6]

260 formulas of black inks and 21 of invisible inks have been collected from primary and secondary literature, particularly from these five treatises.[7] I use the term «formula» to indicate the derived list of ingredients and directions for each specific ink in order to account for authors and compilers who often present alternatives or additional ingredients to the basic formula, resulting in multiple inks derived from a single textual unit or recipe.

By looking at the year of the authors' death, we see that not all treatises have the same relevance, as papyrus was no longer used as a writing support by the end of the 10th cent. A.D.[8] To complicate the matter further, the manuscripts preserving the recipes are much more recent – dating between 13th and 20th cent. A.D. – and the transmission of treatises as well as recipes is extremely fluid. This means that compilers and copyists could modify and restructure authoritative works, creating new texts and, thus, new recipes and formulas in the process.

However, despite the evidence that it was no longer used by the time the treatises were composed or copied, papyrus is still mentioned in some recipes of black and invisible inks. The dual usage of papyrus as both support and ingredient will be investigated in the second and third sections of this paper, while the first chapter will discuss some typological and terminological aspects concerning these specific inks.

Ink typology and terminology

Black inks can be divided into four main types: carbon, plant, iron gall and mixed inks.

Carbon inks are characterised by a suspension of carbonaceous material (charcoal or soot) in a binder (mainly gum arabic but also egg whites, yolks or fish glue) dissolved in a water-based medium. Their colour can vary from dark black to grey, and they do not easily penetrate the writing support.

[4] Smith (accessed 06 March 2019).

[5] al-Marrākušī 2001, 41-54.

[6] Brockelmann 1902, 336 (although his name is given as al-Qallūsī); al-Qalalūsī 2007.

[7] The literary sources used for this paper are mainly selected from the following translations: Fani 2013; Schopen 2005; Levey 1962; the study of black ink recipes was the topic of the author's PhD thesis, Colini 2018.

[8] Youssef-Grob 2015, 431-432.

Plant inks are obtained by macerating or cooking vegetal material (such as bark, flowers, leaves, nuts, berries) that is rich in tannins or colourants. The addition of a binder dissolved in a water-based medium helps to limit the ink's spread on the writing support. The colour varies from light to dark brown, but it may also be dark red or violet, depending on the plant. They tend to fade when exposed to light.

Iron gall inks are the result of a chemical reaction between gallic acid and iron ions in a water-based medium; this produces a soluble complex that oxidises when exposed to air, turning it insoluble and black. Gallic acid is usually obtained from gall nuts that have been cooked, macerated, fermented or pressed, but leaves, bark, fruits and other vegetal materials can also be used. There are various sources of iron ions, such as nails, iron filings and slags, but the most common source is vitriol, a mixture of metallic sulphates. A binder is added to avoid bleeding. The inks penetrate the writing support, and their colour varies between dark brown and black. They often present a brown halo around the writing, and they can even burn the writing support.

Mixed inks are obtained by blending inks (or ingredients) from the previous categories and, for this reason, can be subdivided into mixed carbon-plant inks and mixed carbon-iron gall inks. Their characteristics are a combination of those of the previous types, although their prevalent behaviour is determined by the main components used.

Invisible inks are more difficult to categorise. I group them according to the technique used to reveal the writing: by application of ashes, by fumigation, by heating, by chemical reaction. A fifth type might be added – that which I call magical – since their recipes do not seem to follow any scientific law.[9] It is also important to state that the term «invisible ink» is a modern convention applied to nameless recipes that, in the treatises, are part of chapters entitled *How to write secrets in books* or similar.

Finally, the plant of papyrus is called *bardī* in Arabic. Thus, a term used to identify the writing support made from the papyrus plant is *waraq al-bardī*, although it is rarely used in recipes. Instead, the most common term is *qirṭās* (pl. *qarāṭīs*), from the Greek *chartês* (roll or scroll). When an ink is made for a papyrus support, it is referred to as *midād li-l-qirṭās* (ink for papyrus), as in al-Rāzī; in later authors, however, the same recipes are introduced by titles such as *midād al-qarāṭīs* or *midād min al-qarāṭīs* (ink of papyri). This creates confusion when assessing the use of papyrus in a recipe. When an ink is described as «of papyri» but there is no mention of the writing support or the plant used as ingredient, I assumed that the recipe was originally meant «for papyrus».

[9] It is possible, however, that the magical ingredients are cover names (*Decknamen*) of other ingredients, that we cannot understand anymore.

Inks of papyrus

The writing support (*qirṭās*) – or, in one case, the plant (*bardī*) – are burned to obtain charcoal in six formulas. The only recipe that calls for the charred plant of papyrus is the Persian ink (*midād farisī*) described by al-Marrākušī: a carbon ink obtained by mixing papyrus charcoal with aloe and gum arabic.[10] Although Persian ink is mentioned as an ingredient in a handful of recipes, only two formulas bear the title of Persian ink: the one with papyrus charcoal in al-Marrākušī, and a carbon ink made of date charcoal in ibn Bādīs and al-Malik al-Muẓaffar.[11] Since the former survives in this single occurrence, it is possible that al-Marrākušī made an erroneous attribution. In any case, the fact that the recipe could not be found anywhere else, not even with a different title mentioning another country, suggests that the formula may have become obsolete and was therefore no longer used and copied, possibly due to the unavailability of the papyrus plant in the Arabic world. This recipe is nevertheless interesting because it explains why al-Marrākušī created a section of three recipes entitled *On the preparation of the ink of papyrus* in which only one of them seems to include the ingredient papyrus. Persian ink figures in the ingredients of all three recipes, and since he thought this was made by burning papyrus, he may have assumed that all of them were inks of papyrus. Regarding the use of the term *qarāṭīs* instead of *bardī* in this section's title, I believe that he applied the expression *midād al-qarāṭīs* by extension, as it was already commonly used to identify inks.

In this section I will discuss only the five formulas of mixed carbon-plant inks that clearly mention using charred papyrus sheets, as the Persian ink ones are just al-Marrākušī's speculation. They derived from a recipe by al-Rāzī, in which the ink is obtained by mixing Persian ink with gall nuts and charred papyrus sheets.[12] A variant with different proportions can be found in Ibrāhīm ibn Muḥammad al-Šaybānī's *al-Risālat al-ʿaḏrāʾ*, a treatise on letters that is addressed to the courtier Ibrāhīm ibn al-Mudabbir (d. 893 A.D.), and is contemporary with the *Zīnat al-kataba*.[13] Al-Rāzī's version of the recipe was included by al-Marrākušī in his treatise, in the section concerning the ink of papyrus, where he changed the name accordingly.[14] The recipe appears twice, with some modifications, in ibn Bādīs: in one occurrence, the amounts of the ingredients differ from both al-Šaybānī's and al-Rāzī's versions;[15] in the second recipe, titled Iraqi ink (*midād ʿirāqī*), the quantities are the same as those given by al-Rāzī, but the Persian ink is replaced with an ink obtained from anemone flowers, described by the same author.[16] This Iraqi ink also finds its way into the treatise by al-Malik al-Muẓaffar.[17] Finally, al-Qalalūsī substituted the Persian ink with cork-oak ink.[18]

[10] Recipe MH V 4 in Fani 2013, 123; Recipe 19 in Schopen 2004, 56; Formula 41 in Colini 2018, 167.
[11] Levey 1962, 17 a; Recipe 15 a, Schopen 2004, 53-54; Recipe MM II 3, Fani 2013, 58; Formula 35, Colini 2018, 224.
[12] Recipe R II, Fani 2013, 42; Formula 162, Colini 2018, 224.
[13] Fani 2013, 181; Recipe 96, Schopen 2004, 127; Formula 161, Colini 2018, 224.
[14] Recipe MH V 9. c, Fani 2013, 126-127; Recipe 96 a, Schopen 2004, 127-128; Formula 162, Colini 2018, 224.
[15] Levey 1962, 34; Recipe 96b, Schopen 2004, 128; Formula 163, Colini 2018, 225.
[16] Levey 1962, 17 a-b; Formula 225 Colini 2018, 259.
[17] Recipe MM II 4, Fani 2013, 58; Formula 225, Colini 2018, 259.
[18] Recipe Q I 12, Fani 2013, 140; Formula 247, Colini 2018, 270.

In two recipes by al-Marrākušī, a so-called «plant of Egypt» (*nabāt misrī*) is added to the formulations. It is unclear whether the reference is to papyrus, the Egyptian plant by definition, or to another plant – perhaps the Egyptian starcluster (*Pentas lanceolate* of the family of Rubiaceae) or the common evening-primrose (*Oenothera biennis* L., of the family of Oenagraceae), also known as «wonder of Egypt».[19] However, al-Marrākušī used the term *bardī* when referring to the papyrus plant in the Persian ink. These formulas are extremely complex, with a long list of ingredients.[20] Both inks are carbon based, and vitriol is mentioned in one of them. If it was possible to obtain gallic acid (or at least tannins) from this plant, then the inks would be, respectively, mixed carbon-plant and mixed carbon-iron gall inks.[21]

In five invisible inks, the ashes of papyrus sheets are mentioned as a revelation agent. One of them is the ink made of sour milk (or yoghurt) present in al-Rāzī.[22] Ibn Bādīs and al-Malik al-Muẓaffar quoted the same recipe, while al-Qalalūsī gave the option of substituting papyrus ashes with ones obtained by burning anything else.[23] It is possible that the Andalusian author, aware of the difficulty of finding papyrus by the end of the 13th cent. A.D., wanted to offer a pragmatic alternative.

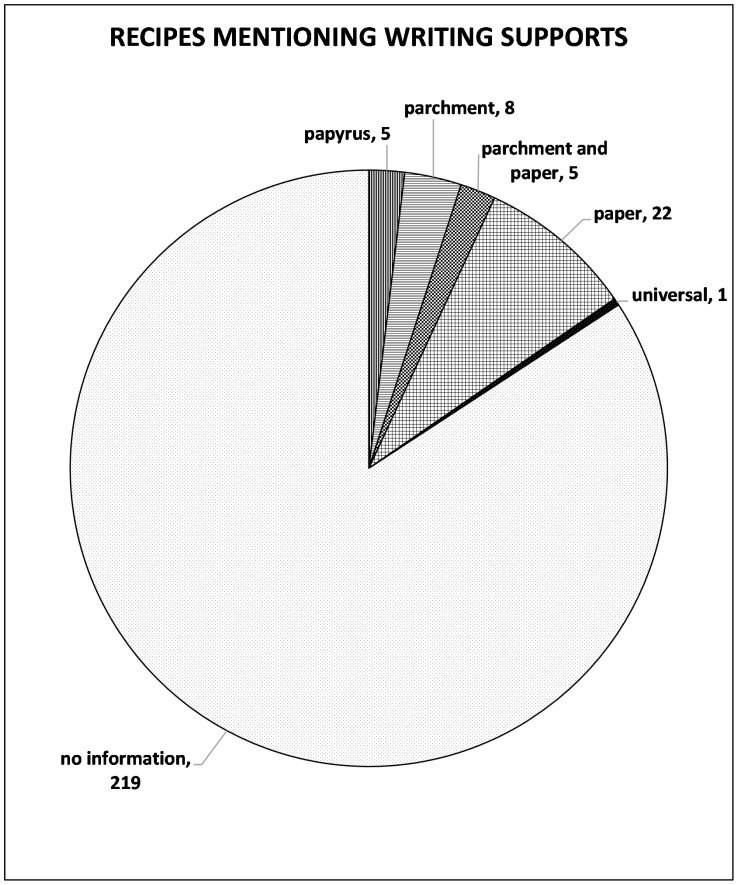
The remaining four formulas are variants by al-Malik al-Muẓaffar of a recipe by al-Rāzī describing an ink that consists of gum ammoniac and is revealed with ashes.[24] Contrary to al-Rāzī, al-Malik al-Muẓaffar specified that the ashes should come from papyrus and listed three other options to perform the writing: with tragacanth gum, a mixture of gum ammoniac and incense, or starch glue. It is possible that since these formulas come right after the recipe of the yoghurt ink revealed with papyrus ashes, the compiler assumed the same precursor for the ashes of these formulas. The three alternatives described by al-Malik al-Muẓaffar have not been found elsewhere, although incense alone (not in a mixture with gum ammoniac) is the second option offered by al-Rāzī for this recipe.

Inks for papyrus

Since writing supports have different characteristics, the writing medium should be optimised for the chosen writing support. However, recipes of black inks often omit this important information: in

[19] Fani 2013, 234; the common evening-primrose, however, seems to be native of North America; USDA, [https://npgsweb.ars-grin.gov/gringlobal/taxonomydetail.aspx?id=25521] (accessed 16 April 2020).
[20] Recipe MH IV 2. g and MH IV 2. m, Fani 2013, 116 and 118; Formulas 193 and 239, Colini 2018, 243 and 266; only one recipe (116) is present in Schopen 2004, 144.
[21] There are no studies on the tannic content of the papyrus plant. However, *Cyperus Papyrus* appears in the «list of species which are also used as a dye or tannin» in Jansen / Cardon 2005, 171. The subject is worth for further studies.
[22] Recipe R XIII, Fani 2013, 46.
[23] Levey 1962, 35b; Recipes MM V 3 and Q VII 1. a, Fani 2013, 74 and 152.
[24] Recipes MM V 4 and R XV, Fani 2013, 74 and 46.

fact, recommendations about the writing supports can be found only in 41 out of 260 formulas (Pl.1). Only six recipes mention papyrus as the intended support, and of these, one is described as fit for any support. The reason for this sporadic clarification might be the fact that most of the treatises were written and copied when paper was the only writing support in use; thus, specifying it would have been redundant. It is not by chance that the writing support is mentioned in five out of the seven recipes of black inks enumerated by al-Rāzī in his treatise, since he lived when papyrus, parchment and paper all coexisted.



Pl. 1. Graph of the recipes mentioning writing support (© C. Colini).

Of the recipes that mention papyrus as a writing support, two are carbon inks, three are mixed carbon-plant inks and one is a plant ink. One of the carbon inks is obtained by mixing Persian ink with gum arabic, while the other uses radish oil soot. The latter appears with the title *midād al-qarāṭīs* in only one manuscript of the treatise by ibn Bādīs: this could suggest a copyist's mistake.[25] The former is present in al-Rāzī as a recipe for papyrus and is similarly copied in ibn Badis's treatise and in al-Marrākušī's section about «inks of papyrus»; here, however, there is no reference to the writing support.[26]

[25] Recipe 7, Schopen 2004, 44-45; Formula 19, Colini 2018, 157; the manuscript is London, British Museum, Or 6273, f 178r; Schopen 2004, 29.
[26] Recipes R I, MH V 9. a in Fani 2013, 43 and 126; Formula 243 in Colini 2018, 268; Levey translated the heading as «soot ink for paper», Levey 1962, 34 a.

Persian ink and gall nuts are the ingredients blended in the first mixed carbon-plant ink: the mention of papyrus as a writing support comes exclusively from al-Marrākušī, since both al-Rāzī and ibn Bādīs specify that the ink is intended for paper.[27]

I have already discussed the other two mixed ink formulas in the chapter about inks of papyrus. Al-Rāzī intends for the ink formulation based on charred papyrus sheets, Persian ink and gall nuts to be ideal for use on papyrus and paper.[28] The writing support is not mentioned in any of the other treatises in which the formula or its variations appear, with the exception of the variant by al-Qalalūsī. This formula, which uses cork-oak ink, charred papyrus sheets and gall nuts, is also the only black ink that its author identified as for papyrus.[29]

The plant ink is prepared by dissolving the anemone flowers with dung heat. This recipe is described by al-Rāzī as an ink that cannot be erased from papyrus, paper or any writing support, while al-Qalalūsī does not mention any writing support; according to al-Marrākušī, however, the ink cannot be erased from parchment and paper but, when used on papyrus, it will last only a few days.[30]

It is striking that there is no mention of papyrus as a writing support in any recipe of iron gall ink, although this type was known and used in the Arabic context from at least the 8th cent. A.D.[31] This category is by far the most common among the ink recipes (ca. 53% of the total), and it is the preferred type for the other supports. In fact, iron gall is the type recommended by 13 out of 14 inks intended for parchment, and by 19 out of 28 inks intended for paper. Similar conclusions may be drawn about the use of mixed carbon-iron gall inks, although these recipes are related only to paper; this may be because the recipes started to be recorded around the 13th cent. A.D.

The situation is completely different for the invisible inks. Of the 21 formulas collected, ten mention the writing supports they are destined to, and they all include papyrus. Four of them are explicitly meant for papyrus, one can be used also on parchment, and the remaining five mention all supports.

Al-Rāzī is the source of nine of the formulas; although they were integrated and modified in the treatises of later authors, the mention of writing support in these later texts is rare or non-existent. Three formulas are revealed by application of ashes: the yoghurt (or sour milk) ink,[32] a soaked gum ammoniac one, and a soaked incense one.[33] Three others are revealed by fumigation: the dissolved ammonium chlorine ink, a soaked gum ammoniac one, and a soaked incense one.[34] One formula relies

[27] Recipes R III and MH V 9. b, Fani 2013, 42 and 126; Formula 165, Colini 2018, 226; Levey 1962, 34a-b.
[28] Recipe R II, Fani 2013, 42; Formula 162, Colini 2018, 224.
[29] Recipe Q I 12, Fani 2013, 140; Formula 247, Colini 2018, 270.
[30] Recipes R IV, MH IV 2. d and Q I.18, Fani 2013, 43, 114-115 and 142; Formula 238, Colini 2018, 266.
[31] See for example the analytical results obtained on early Qur'anic fragments preserved in the Library of Congress, Khan / Lewincamp 2008, 61-62.
[32] Recipes R XIII, MM V 3 and Q VII 1. a, Fani 2013, 46, 74 and 152; Levey 1962, 35 b.
[33] The formulas are two alternatives of the same recipe: R XV, MM V 4 and Q VII 1. d Fani 2013, 46, 74 and 152.
[34] The formulas are three alternatives of the same recipe: R XVI, MM V 2 and Q VII 2 Fani 2013, 47, 74 and 153; Levey1962, 35b.

on the chemical reaction between gallic acid and iron ions: the writing is done with a solution of vitriol and is revealed with the macerated gall nuts, or vice versa.[35] This recipe also demonstrates that iron gall ink was known and used to write on papyrus in al-Rāzī's time. Finally, two formulas are magical: one mixes pigeon's blood with ink, and the other uses whitefish's bile as ink; both will result in invisible writing that glows like gold at night.[36]

The tenth recipe that mentions papyrus is found in the *Kitāb manāfiʿ min aʿḍāʾ al-ḥayawān*, a compilation on the useful properties of parts of animals, written by the Syriac physician ʿĪsā ibn ʿAlī in the 9th cent A.D.[37] It is a magical ink: the writing, done with tortoise bile, will be visible at night without a lantern. The same formula, with no mention of writing support, appears in al-Rāzī and al-Qalalūsī.[38]

The formulas that are intended for papyrus only are the writing with yoghurt and the three magical ones. It is interesting to note that the former is meant for papyrus also in ibn Bādīs and al-Malik al-Muẓaffar, while the formula with pigeon's blood is the sole mention of papyrus by al-Qalalūsī among the invisible inks.

Conclusions

Papyrus was a valuable good: its cost and scarcity were among the causes of its replacement with paper.[39] The versos were often reused for all kinds of documents in order not to waste it, sometimes even the blank spaces between the lines of rectos were filled. Palimpsesting techniques were also employed, as proven by al-Rāzī's instructions on how to erase writing from papyrus with wax or incense.[40] Consequently, burned papyrus was most likely written papyrus that had lost its functionality (for example, by being too worn out or damaged).[41] As a supplemental hypothesis, papyrus could have had such symbolic value for literate people that adding its charcoal to an ink could make it more precious and appreciated. Likewise, the use of papyrus ash, in place of a generic one, might have added a magical dimension to the act of revealing invisible writing.

The occurrence of papyrus as a writing support greatly differs between black and invisible ink recipes due to several factors related to their transmission. Black inks were more commonly used. This simple fact means that the recipes were more often modified when they were copied: ingredients were replaced, added, removed or generally updated to suit current needs, and their quantities and

[35] Recipes R XIV, MM V 1 and Q VII 1. c, Fani 2013, 46, 73 and 152; Levey 1962, 35 b.
[36] Respectively Recipes R XXV and Q VII 4, and R XXVII and Q VII 3; Fani 2013, 48-49 and 153.
[37] Raggetti 2016, 324-325.
[38] Recipes R XXIII and Q VII 3; Fani 2013, 48 and 153.
[39] Shatzmiller 2018, 466-470; Malczycki 2011, 189-194.
[40] Recipe R IX, Fani 2013, 45.
[41] Luijendijk 2010, 240-250.

ratios were altered. This active transmission spawned many new variant formulas. By contrast, the recipes of invisible inks did not change much over time. This constancy is due partly to the lack of quantities and ratios given, which removed a source of variation, and partly to their lack of practical application, which turned them into symbolic elements that were included for the sake of completeness but seldom tested or updated. Therefore, their transmission was compilatory and passive, rarely leading to the creation of new formulas.

That being said, specification of the writing support was often omitted, particularly in later renditions of invisible inks. It is no coincidence that the recipes that mention the writing support can be found mainly in al-Rāzī and originate from his time, when paper, papyrus and parchment coexisted. When paper emerged as the most popular (and then as the only) writing support, it became redundant to specify its use, leading to the omission of its mention in later treatises and copies. In my opinion, the presence of papyrus as writing support should be regarded as a sign of the compilatory nature of the transmission of the particular text in which it is found; concurrently, it could also be understood as a sign of the power and authority of a specific source in the eyes of its compilers, who decided not to alter that particular text.

Looking at these recipes, it seems that carbon and mixed carbon-plant inks were preferred for writing on papyrus, while iron-gall inks were the most common media used on parchment and paper. Even the recipe to erase writing from papyrus is truly effective only on carbon inks. This finding leads to the hypothesis that different ink types were meant for different writing supports.

Thanks to the application of several scientific techniques, it is possible to analyse the inks in manuscripts and thus to compare the results of this research on recipes with the evidence from the written artefacts themselves.[42] A preliminary study performed on 15 Arabic fragments from the Austrian National Library (ÖNB) in Vienna, however, already disproves the aforementioned hypothesis. The 15 manuscripts are all dated between the 10th and the first half of the 11th cent. A.D. and were found in Egypt; they consist of seven fragments on paper, three on parchment and five on papyrus, from various documentary typologies.[43] Concerning papyrus, carbon-based inks have been identified on legal documents, receipts and letters, while all the protocols were instead written in iron gall inks. On paper, carbon-based inks were identified on legal documents, while iron gall inks were mainly found on paraliterary texts such as almanacs and ephemerids. Of the fragments on parchment, a marriage contract was written with iron gall ink, while a contract of sale and a horoscope were written with carbon ink.

[42] This is among the goals of the research project RFA01 The Scribe's Choice: Writing Supports in Arabic Documents of the Early Islamic Centuries, part of the Excellence Cluster 2176 *Understanding Written Artefacts*, Universität Hamburg.
[43] They are: CPR III 181, 187; CPR XXI 72, 82, 83; CPR XXVI 7; PERF 916, 925, 1181; Chrest.Khoury II 2; Nilus XXII 53, 61, 63, 65, 66; references from Arabic Papyrology Database (APD). The author would like to thank the Director Bernhard Palme and the staff at the ÖNB, Vienna, for their support in this research.

A study on Coptic manuscripts suggests that the choice of ink typology is not linked to the writing support but to the type of text: carbon inks prevail among the documentary fragments, while iron gall inks prevail among the literary manuscripts.[44] The same trend seems to hold true here, with the papyrus protocols being one of a few exceptions. The corpus, however, is too small to draw any general conclusion. With the progress of the research and the analysis of a higher number of written artefacts, I hope to be able to discover more specific trends connected to the materiality of writing in order to shed light on the scribal practices used in different milieus and centres, and on the writing habits of scribes, notaries, witnesses and others involved in manuscript production.

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[44] Ghigo et al. 2020, 10-11.

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