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Cartas Ejecutorias de Hidalguía (executory certificates of nobility): a survey in materials analysis, legal, and aesthetic contexts—two case studies

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Abstract

Illuminated manuscripts are relatively well studied, but the available publications greatly focus on religious manuscripts of a geographically limited area. In contrast, technical examinations of illuminated legal documents have received far less attention, e.g., Spanish *cartas ejecutorias de hidalguía* (executory certificates of nobility). These documents are suitable case studies to deepen current knowledge of manuscript-making in Spain for two reasons: First, they are dated (late fifteenth to early eighteenth centuries); and second, they are unusual and understudied from both the textual and materials analysis standpoints. *Cartas* contain judicial proceedings whereby a family gained or was re-assigned *hidalguía* (lower nobility). A key exhibit to achieving this status was proving their “blood purity” which implied they were faithful Catholics, so finding religious representations within the document is common. In addition, families embedded their faith and links to monarchs in their coat of arms through symbols like crowned eagles, trees, and towers. The deliberate choice of heraldic and religious elements is as important as the materials used to produce them. Interested in better understanding illumination in Spain we are studying these unique documents from the historical, materials, and iconographic points of view. Herein, we present the earliest results of an ongoing survey, detailing two case studies: Davila and Nuñez D. Armesto *cartas*. This research uses a combination of: (a) instrumental techniques (X-ray fluorescence, reflectance, and infrared spectroscopies; peptide mass fingerprinting; and gas chromatography); and (b) historical research using both the manuscript’s contents as primary sources, and published research. The preliminary results are enabling us to shed light onto Spanish (legal) illuminated manuscript-making, and the symbolic role materials played, e.g., use of precious metals adorning monarchical elements, presence of ultramarine mixed with azurite on both coats of arms, and on Virgin Mary’s gown, etc. This survey intends to simultaneously learn more about illumination practices in Spain, inform conservation decisions, and hopefully better understand problems connected to historic ideologies that were legalized in beautiful albeit disturbing documents, e.g., persecution of non-Catholics at the time in Spain.

Keywords Carta ejecutoria, Certificate of nobility, Iconography, Spain, FORS, XRF, PMF, Illuminated manuscript

Introduction

Cartas Ejecutorias (executory certificates)

The Spanish term *reales cartas ejecutorias* refers to legal documents emitted by the Spanish authorities containing the resolution of judicial proceedings, including criminal cases [1], land disputes [2], and noble status claims [3]. Although they are invaluable primary sources due to

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their intellectual and artefactual significance, they remain understudied from a global standpoint [4]. *Cartas ejecutorias* were symbolically emitted by the Monarch himself, by using his image and name throughout [5], and they resulted from—frequently decades-long—judicial litigations that included witnesses [6]. The Spanish term for these proceedings is *pleito*, which may be translated as lawsuit, but given the unique proceedings they covered, we have chosen to use the original term (pl. *pleitos*); and to translate *cartas ejecutorias de hidalguía* as executory certificates of nobility, as the outcome of these *pleitos* was royal and definitive, therefore expected to be “executed” promptly.

Cartas Ejecutorias de Hidalguía (executory certificates of nobility)

Cartas ejecutorias de hidalguía, often known in English as patents of nobility [7, 8], are a unique subset of executory certificates that focus on *pleitos* for individuals to become, or regain, *hidalguía* (lower nobility status). These types of executory certificates are also referred to as *privilegios* (privileges) or *privilegios de nobleza* (nobility privileges), as the outcome privileged the person or family initiating the process [9]. Since there were *privilegios de villazgo* (village privileges), *privilegios de peaje* (toll privileges), and *privilegios de pasaje* (passage privileges) but none are part of the research we are discussing herein, we will not use the term *privilegios* nor its English translation (privileges). Instead, we will use the original word in Spanish—*carta*—and the translation we deemed most adequate—certificate—interchangeably, even when it has been translated as patent. Choosing to use the word certificate over patent is deliberate because, in our view, the latter captures better the contents’ essence.

The executory certificates of nobility were issued between the late 15th and the early 18th century by the Spanish Royal Chancelleries and detailed the judicial proceedings legitimizing that a person was a *hidalgo de sangre* (hidalgo of blood) [5]. The only valid route to claim *hidalguía de sangre* was via the male bloodline. The requester(s) had to meet a lengthy list of specific criteria that included proving, through witnesses and primary sources, that their blood was pure and therefore noble, i.e., they were not descent from Moriscos or Pharisees, nor they were Christian converts [7]. Furthermore, they had to prove they were legitimate sons, had fathered only legitimate children (if applicable), and demonstrate knowledge wielding weaponry [4].

Hidalguía could come through kinship and through filing for an executory certificate of nobility. Even direct descendants had to file a *pleito* to be legally recognized as *hidalgos*, a designation supported by a court amendment of the original document [9]. While they

were acknowledged as *hidalgos* in their villages based on ancestry and word-of-mouth, those that moved away from their original municipality had to start a *pleito* against their City Council get their social promotion [10]. The “need” for such a distinction originates from social standing and tax exemptions, benefits that set *hidalgos* apart from the ordinary tax-paying people, referred to as *pecheros* [10]. The desire to become *hidalgos* was so prominent that there are records proving genealogical fraud [11, 12]. These “blood-purity” documents were reprobable and astonishing outside Spain even then, e.g., non-Christians were prosecuted for their faith also in Rome, but they received relatively more lenient sentences there than in this Iberian country [9].

Conceding such titles and, consequently, tax exemptions to numerous requesters, represented a disadvantage to the Spanish monarchy, as their income relied heavily on such contributions [5]. The *Sala de Hijosdalgo* (Chamber of Sons of Something) was the court created inside the Royal Chancellery that dealt with *hidalguía* proceedings. Created in 1494, it remained active until 1838. The exact number of *cartas* is unknown, but the growing interest in these documents for their content and form sparked the ongoing efforts to document and conserve the ones kept at the Royal Chancellery of Valladolid Archive, where the greatest number of *cartas* is safekept [13, 14].

The verdict on a *pleito* was materialized with an executory certificate of nobility, and the wealthy would take their *carta ejecutoria* to a scribe, who would recreate the calligraphic script and rich ornamentation to produce a booklet [8], like the case studies discussed herein (Figs. 1, 2, 3, 4, 5). Since these scribes were not part of the Chancellery, the embellished copy was taken to the *Real Chancillería* to check its contents against the original. When the faithfulness to the original had been verified, both copies were dated, signed, and sealed with a hanging lead seal [8].

Unlike religious texts such as psalters, gospels, and books of hours [15–21], technical examinations of legal documents are scant, with exceptions like the Mexican act of Independence [22]. Spanish executory certificates of nobility are relevant to understand both the society of the time, and the role of materials and techniques employed to enhance judicial content, including the verdict. The executory certificates from the Royal Chancelleries of Valladolid and Granada “occupied an outstanding place amongst the judicial documentation with high symbolic value for the nobility. These probatory documents, as well as the titles and privileges they granted, were notably aligned to medieval materials and techniques”—including illuminations [1].



Fig. 1 Nuñez D. Armesto D. Arce (Nuñez D. Armesto) family *carta ejecutoria de hidalguía*, granted in 1792. **a** Closed manuscript covered in red velvet. **b** Open pages showing illuminations. **c** Embellished beginning of the section where the monarch, Carlos IV, is named—note the multiple places where he is the king (*REY*), i.e., Castilla, Leon, Aragon, etc. **d** Family's coat of arms

As with any other legal document, all *cartas* follow a standard textual format that begins with an *intitulación* (equivalent to opening statements) where the person(s) claiming nobility are named, followed by a list of the judges (Fig. 3a). Everything that originates the certificate's narrative is called *parte expositiva* (exhibits part) and includes a summary of claims; and if applicable, any prior rulings. Once a decision was made, the document was to include a *parte dispositiva*, where the ruling was described (Fig. 3b). *Cartas* finish with information about when, where, and by whom these decisions were made [6], e.g., Fig. 5a.

Illuminations and illuminators in Spain

The available published resources on Spanish illuminations focus mostly on the twelfth through the fifteenth centuries. The transition from hand-written to printed documents was slow, and manuscript traditions prevailed on formats like antiphonals, missals, and executory certificates, including the executory certificates of nobility [9].

Juana Hidalgo argues that earliest illuminated manuscripts in Spain date back from the Visigoth Kingdom, starting in the 10th c. the style “Beato” appears, influenced by the Mozarabic and Oriental styles. The illumination tradition was especially influenced by the French (e.g., Cluny Order's) because of the arrival of French monks to Spanish Monasteries. The 13th c. fashion shifted to gothic with the arrival of Alfonso X, remaining in place in various degrees of French-Gothic for a century until the 15th c., when a Flemish style—particularly the Benings' influence—takes over with the rise of the Crown of Castille. The century that followed saw multiple areas of Spain becoming specialized in religious miniature-making (e.g., antiphonals): Castille (Toledo school), Extremadura (Guadalupe Monastery), Andalucía, and El Escorial [9].

Illuminating manuscripts in Spain went beyond decorating religious texts, poems, and even novels, because administrative and civil documents were embellished too. In fact, there were illuminators in, but not working for, the Chancelleries of Granada and Valladolid who



Fig. 2 Davila family's *carta ejecutoria de hidalguía*, granted in 1608. **a** Closed manuscript, leather bound, with blind-tooled decorations. **b** Open pages showing an historiated letter. **c** Detail of historiated letter depicting the reigning monarch to symbolize He oversaw this judicial proceeding. The text reads in Spanish (spaces added to increase readability): *Don Carlos por la divina clemencia emperador semper augusto rey e ave María DOÑA Juana su madre e mismo Don Carlos por la gracia de DIOS Reyes de Castilla [...]* Approximate translation: Don Carlos through the divine clemency emperor always magnificent and hail Mary DOÑA Juana his mother and Don Carlos himself, by the power of GOD monarchs of Castille [...]. **d** Family's coat of arms. Photo credits: J. Schneck, JAG, VMO

embellished civil documents such as *privilegios* and *ejecutorias*. Spain is the only European country with this tradition, which peaked during the sixteenth century with the executory certificates [9].

Perhaps the most extensive publication on illuminated manuscripts analyzed in Spain is from Salvador Muñoz Viñas and Eugene F. Farrell: 11 codices from the Historical Library of the University of Valencia. Each of them is connected to Spain through history, but all are Italian-made [23]. Other works on Spanish manuscripts focus on early Islamic documents, including the Spanish Cava Bible (ninth century), and letters sent to the Spanish Umayyad Caliph Abd al-Rahman III by the Byzantine Emperor Constantine VII (947-951 CE) [21].

Symbolism in *Cartas Ejecutorias*

Illuminating manuscripts symbolically enhanced a patron's power and legitimacy. While the primary value of legal documents lies with the text, Spanish law added

further value through illuminations between the late fifteenth and the early eighteenth centuries (Ancient Regime). By embellishing material culture, including legal documents, the privileged classes ensured their privilege was physically evident to everyone. Finding intricate ornate certificates of nobility is therefore, expected.

The materials and techniques resembled Medieval illuminated manuscript practices even after the advent of the printing press. Keeping alive such traditions had “a symbolic added value, an intrinsic relationship between antiquity, exclusivity, and legitimacy” [1]. Text is written with minimal space between letters and without periods, with illuminated letters—inhabited, historiated or decorated—to mark sections (Figs. 1, 2, 4, 5). There is a historiated letter that introduces the reigning monarch which visually highlights this person's power and therefore makes it clear that He—capitalized—is at the center of the process [24] (Figs. 1c and 2c).



Fig. 3 Details in Nuñez D. Armesto's *carta* showing stamped seals. **a** *Intitulación* page: opening statement page where Don Antonio and Don Gregorio Nuñez are mentioned as the requesters; and Don Miguel, Don Clemente, and his sons are named as witnesses. Note the word “*corregida*” on the bottom right, stating that this is an amended *carta*. **b** *Parte dispositiva* page: ruling page where a lead seal is mentioned: *escrita en papel, sellada con nro sello de plomo pendiente en un corton de seda de diferentes colores* translated to English as “written in paper, sealed with our lead seal hanging from a multicolored silk thread”. **c** Page on the amended portion where the cost (20 *maravedis*) and the year, 1793, were stamped next to the royal seal. **d** Page on the amended portion under UV (scale is upside down)—note ink damage in both visible (**c**) and UV illumination (**d**). Photo credits: JAG and VMO

Heraldry

Coats of arms are ubiquitous in *cartas ejecutorias de hidalguía* as they were linked to the family filing to gain or regain nobility (Figs. 1d and 2d). Heraldry has a rich past still evident in present-day Spain and in many of the historically connected places such as Latin America. The twelfth century marked the beginning of hereditary rights that linked families through blood lineage. Coats of arms became part of a family's identity, visually representing the values and history of every *Casa* (House), each branch selecting their own interpretations and traditions to honor it. Coats of arms contain schematic

figures and symbols that shifted from the exclusively military, to relevant emblems of economically independent individuals, in part influenced by epic literature [25].

Each *Casa Hidalga* (a house of nobles or *Hidalgos*) would display their coat of arms whenever possible, emphasizing that its use was only reserved to those of the right lineage branch—the male and pure bloodline. Utilizing these symbols relates to the idea of “perfecting” lineages through kinship and traditions. Therefore, heraldry is connected to nobility, although coats of arms usage eventually extended to the clergy, all social strata, and their conquered territories [26, 27]. Many areas of Spain, like the Kingdom of Navarra, registered all coats of arms in the *Libro de Armería del Reino* (Kingdom's Book of Armory), allowing only those recognized by the authorities to use them.

Some scholars believe that coats of arms were reserved for *caballeros e hijosdalgos* (knights and lower nobility peoples), and were either passed through lineage, or given by monarchs for their merits and achievements; but the new nobility could also request one [28]. Each of these pictorial representations encapsulates a family through symbolism so combining weaponry, animals, geometric figures, etc., enabled a mostly illiterate society to identify lineage more accurately than with a surname [28].

Materiality of Cartas Ejecutorias

Cartas ejecutorias were handwritten by the tribunal's scribe(s), sewn as *cuadernillos* (signatures) to a textbook, custom bound, and embellished with colored threads (e.g., Fig. 4c). The writing supports could be either laid rag paper or parchment, for the more luxurious ones, which were further decorated. If scribes used parchment and had illuminated folios, they interleaved colored silk between them [9] (Fig. 4a and b).

Scholars have identified round gothic as the primary script (e.g., Fig. 4b, c), which in Spain was a result of Visigoth and French influences during the Middle Ages (beginning in the tenth century). This is why some paleographers refer to this letter as the *letra de privilegios* (letter of privileges), having been extensively used in such types of documents (see Section “*Cartas Ejecutorias (executory certificates)*”). Round gothic continued to be the main script for legal documents during the reign of Carlos I, Felipe II, and Felipe III; but during Felipe IV's reign, the script changed to *grifa* and *romanilla* (Roman type) [9].

The overarching goal of this project is to contribute to the knowledge of illumination practices in Spain, using *cartas ejecutorias de hidalguía* as a first approach, as they represent a unique subset of well-dated Spanish documents. The project studies the materiality and craft used



Fig. 4 **a** Carta ejecutoria de hidalguía a pedimiento de Rodrigo Calera, v[e]l[z]ino de Villarrobledo showing red silk sewn into the manuscript where illuminations are present (3V, 4R). **b** Executoria de hidalguía a pedimiento: de Juan de Mena Gutierrez, vezino de la villa de Los Santos (48V, 49R). Note the silk sewn into the manuscript, where illuminations are present; and the decorated letter F that precedes de ruling in favor: *Fallamos QVE* (we rule that). **c** Carta executoria de hidalguía a pedim[en]to de Alfonso de Mo[n]talva[n], v[e]l[z]ino de la ciudad de Sevilla (15V, 16R) where colored threads that used to hang a lead seal are still present. **d** Microphotograph of metal-wrapped thread of **c**, 200 \times . Photo credits **a–c**: Kislak Center for Special Collections, Rare Books, and Manuscripts, University of Pennsylvania Libraries

in *cartas* from legal, artistic, symbolic, and materials analysis standpoints, and herein, we present the earliest results of this ongoing survey of such manuscripts in the United States. We discuss in detail two *cartas ejecutorias de hidalguía* housed at the University of Delaware Morris Library, Special Collections: Davila family and Nuñez D. Armesto de Arce family, the latter referred to as Nuñez D. Armesto, for simplicity. These case studies include historical context, visual examination, and non-to-minimal sampling analysis to identify illuminating materials and colorants, writing media, writing supports, and bookbinding materials. Simultaneously and to further shed light on executory certificates of nobility, we touch on selected materials we have examined in person at the University of Pennsylvania Kislak Center for Special Collections, Rare Books and Manuscripts (Figs. 4, 5c, 8). We will discuss the materials, Catholic iconography, and heraldry in this unique legal context: the Catholic Spanish Monarchy.

Materials and methods

Microscopy

Normal-light magnified examination was performed with a Nikon SMZ1500 at 0.75 \times magnification; polarized microscopy was performed with a Nikon Optiphot Pol (N189 228964).

Ultraviolet and infrared reflectance photography

IR photography was used on the Davila's *carta* wax seal, while both UV and IR photography were carried out on the three full page illuminations of Nuñez D. Armesto *carta* with the following equipment: a modified Nikon D800 DSLR with a CCD detector and equipped with XNite No. 830 IR filter (750–1050 nm wavelength range), and XNite 330 nm UV filter.

Energy-dispersive X-ray fluorescence (ED-XRF)

An ArtTAX μ XRF spectrometer was used on the Nuñez D. Armesto *carta*, equipped with a rhodium tube (600 μ A current, 50 kV voltage, 100- and 10-s live time



Fig. 5 Details of seals on *cartas ejecutorias de hidaguía*. **a** Mention of a lead seal in Nuñez D. Armesto's *carta* in Spanish: *escrita en papel, sellada con nro sello de plomo pendiente en un cotton de seda de diferentes colores*, translated to English as "written in paper, sealed with our lead seal hanging from a multicolored silk thread". **b** Wax seal in Davila's *carta* under raking visible light. This type of wax seal is known in Spanish as *sello monofaz y con contrasello heráldico*, translated literally to English as single faced and with heraldic counterseal (Photo credit: J. Schenck). **c** Wax seal on Don Alonso Alvarez de Toledo's *carta* under visible light (Photo credit: Kislak Center for Special Collections, Rare Books, and Manuscripts, University of Pennsylvania Libraries, OCLC: 155962669). **d** Infrared image of wax seal in Davila's *carta* (Photo credit: J. Schenck)

irradiation, 70–100 μm spot size) with element detection range of potassium (K) to uranium (U). An integrated CCD camera allowed capturing magnified images of the region of analysis.

Additionally, and because of unexpected ArtTAX malfunction, Davila's *carta* (paper and illuminations) was examined using a handheld Bruker Tracer III-SD XRF spectrometer with a rhodium tube (40 kV high voltage, 9.6 μA anode current, 25 μm Ti/305 μm Al; 15 kV high voltage, 55.00 μA anode current, no filter) for 120 s live time irradiation. The oblong-shaped spot size and measures 1 cm \times 0.5 cm. Spectra for both *cartas* were interpreted using the Intax version 4.5.18.1 software.

Fiber optic reflectance spectroscopy (FORS)

Reflectance spectra were collected using an ASD Inc. FieldSpec 4 Hi-Res portable FORS spectrometer equipped with a VNIR (350–1000 nm detector, 512 element NIR-enhanced silicon array), and two 2-stage

TE cooled SWIR detectors (SWIR1 1000–1800 nm and SWIR2 1800–2500 nm) using the RS3 v. 6.4.0 software. All measurements were performed using a bifurcated fiber optic contact reflectance probe consisting of a common end of six optical fibers (600 μm diameter) surrounding a single collection fiber (600 μm diameter). Resolution in VNIR and SWIR are 3 nm and 8 nm, respectively. Illumination and detection were perpendicular to the surface using a hand-held pistol grip, which secured the probe approximately 2 mm above the measured surface. Calibration was done with a white reference Spectralon[®] panel. Spectral acquisition (spectral average) is 50, and five spectra are taken in each spot. Spectral processing within ViewSpec Pro v. 6.2.0 (ASD Inc.) was used solely for splice correction between the three detectors. Three data sets for each spot were taken, resulting in identical spectra with negligible variance so only the second spectrum of each spot was plotted and interpreted using Microsoft Excel and published references.

Fourier transform infrared spectroscopy (FTIR)

Three velvet samples from Nuñez D. Armesto's *carta* binding were analyzed using FTIR on transmission mode. The first was retrieved from a detached fiber bundle found in the enclosure; the second and third samples were retrieved from the lower board's tail joint and the tail spine, using a stainless-steel tweezer and the aid of a stereomicroscope. Each sample was analyzed by placing the fibers directly on a diamond cell. The material was rolled flat on the cell with a stainless steel micro-roller to decrease thickness and increase transparency. The sample was analyzed using the Thermo Scientific Nicolet 6700 FT-IR with Nicolet Continuum FT-IR microscope (transmission); data was acquired for 128 scans from 4000 to 650 cm^{-1} at a spectral resolution of 4 cm^{-1} . Three spectra were collected with Omnic 8.0 software and analyzed in this program with various IRUG and commercial reference spectral libraries.

Peptide mass fingerprinting (PMF)

Eight micro-destructive samples were taken from Nuñez D. Armesto parchment using the rubbing method described next, four from the verso of each full-page illumination. Staedtler or Pentel vinyl erasers were cut into pieces approximately 2–3 mm square and 4–6 mm long with a clean scalpel. The pieces were held with tweezers and gently rubbed over a small area of the surface to be sampled. Rubbings were removed using tweezers and placed into an Eppendorf tube to be solubilized in 30 μL trifluoroethanol and 30 μL 50 mM ammonium bicarbonate (AMBI) at 60 $^{\circ}\text{C}$ for 45 min with intermittent vortexing/agitation. Following solubilization, samples were

digested with 8 μL trypsin (0.02 $\mu\text{g}/\mu\text{L}$ in 50 mM AMBI) at 37 °C overnight.

Exact masses were measured with matrix assisted laser desorption ionization time-of-flight spectrometry (MALDI-ToF) using a Bruker MicroFlex MALDI-ToF on positive ion mode from 800 to 3800 Da with mass accuracy of ± 0.1 Da (University of Delaware Mass Spec facility). An alpha-cyano-4-hydroxycinnamic acid (αCHCA) matrix was prepared as a saturated solution in 40% (V/V) acetonitrile (ACN)—0.1% trifluoroacetic acid (TFA). 4 μL of each digested sample were mixed with 20 μL of matrix in a separate tube and spotted on the MALDI plate. Peptide standards were used as external calibrants.

Results and discussion

Discussing the results of two *cartas ejecutorias de hidalguía* case studies offers a glimpse into the wide variety of bound manuscripts this legal genre encompasses. These case studies are part of two ongoing parallel projects that survey collections in the United States of America-based institutions, beginning with those held at the University of Delaware (Special Collections) and the University of Pennsylvania: (a) from the materials perspective using instrumental analysis, and (b) from the bookbinding traditions perspective, both relying on visual examination and historical context. Together, these two projects deepen current understanding of illumination practices in Spain and contribute to learning about the symbolism in legal documentation between the late fifteenth and early eighteenth centuries in this Iberian country.

Unlike the *cartas ejecutorias de hidalguía* kept in Spain at the Royal Chancellery of Granada, National Archives, Historic Archive of Nobility, and other divisions of the Ministry of Culture, the *cartas* discussed here are held by academic research libraries in the U.S. and are in a way isolated from their historical context: the online acquisition records we have consulted are not connected to families but rather to book dealers, e.g., Lawrence J. Schoenberg purchased Juan de Mena Gutierrez's *carta* (Fig. 4b) at a Sotheby's auction in 1979, and subsequently donated it to the University of Pennsylvania. In Spain, *cartas* remain in historic archives and public genealogical records, valued both by their textual and aesthetic contexts, albeit still understudied. Despite their prominence, to our knowledge, this is the first big undertake to understand their materiality, aided by instrumental methods, in addition to historical research. It is therefore our goal to contribute to better understanding their use, their making, and their long-term preservation.

The two manuscripts discussed in greater detail are verdicts that conferred *hidalguía* to the Nuñez D. Armesto family in 1792 (Fig. 1) and Davila family in 1608 (Fig. 2), who initiated *pleitos* at the Royal Chancelleries

of Valladolid and Granada, respectively, and who were declared *hidalgos*. For each of these there should be a second copy, as two identical documents were prepared by the Chancellery's clerk, one for record-keeping, and a second one for the applicant. As stated in the introduction, the wealthy's copy could have ornamentation added, and after confirming original and copy stated the same, both documents were dated, signed, and sealed [8].

Both case studies discussed in this paper are *cartas corregidas*, amended documents that expand upon the original *cartas ejecutorias de hidalguía* emitted by the Royal Chancelleries to the Nuñez D. Armesto and Davila families: each amends the original *carta* to include more family members after the original ruling (Fig. 3a). This was common practice that responded to a growing number of *pleitos* filed beginning in the sixteenth century to increase a family's privileges [9]. How the manuscripts arrived in the United States is unknown but archival records at the University of Delaware Morris Library Special Collections indicate these two were donated by the Moyerman family in the 1970s [29].

Pleitos (disputes) and heraldry

All certificates of nobility we have examined in person are lengthy, detailed documents that outline the *pleito*, specifics of the family's *hidalgo* alleged status, and the rulings in their favor—we have encountered only rulings (*fallos*) in favor (Fig. 4b). Each dispute follows the described traditions, listing the persons interviewed and their role in deciding the families' noble status [6]. Additionally, if a hanging seal was to be added, the concluding text describes it, and although the colored threads, frequently metal-wrapped, are still visible in many *cartas* (Figs. 4c and d), this type of seal is not present in any of the 11 manuscripts examined in person.

Nuñez D. Armesto

The Nuñez D. Armesto family's certificate describes how the siblings Agustín and Gregorio Nuñez from *Villa de Pollos* submitted a request to the Royal Chancellery of Valladolid on May 27, 1773, aiming to obtain an amended (*corregida*) copy of their family's certificate (Fig. 3a). The siblings alleged being legitimate heirs of Arias Nuñez and Catalina Dominguez, who were *hidalgos ejecutorios* themselves since 1582. These siblings requested a corrected copy of the *carta ejecutoria* where they and their offspring were included. Doing so would make them regain their *hidalguía* in both *Villa de Pollos* and *Castronuño*, with the previously described benefits. This manuscript was issued by the Spanish Royal Chancellery of Valladolid during the reign of Carlos IV.

The work of Luis Valero de Bernabé and Martín de Eugenio [28] catalogued 55,000 coats of arms in Spain,

but unfortunately neither this family's (Fig. 1d) nor the Davila's (Fig. 2d) were identified. However, from their work, combined with the Manual of Heraldry by Eduardo Pardo de Guevara y Valdés [25] we can infer the Nuñez D. Armesto family's strong connections to the monarchy, evident both through the individual elements of their coat of arms and the materials used to create it (Section "Illuminations and iconography"). In particular:

- (a) The *tahalí* (baldric), represented by a diagonal line, is reserved for the oldest, most illustrious Casas, only to be worn by noblemen and knights fighting on behalf of monarchs.
- (b) The eagle, the tree, and the tower are Christian symbols of power, generosity, and magnanimity.
- (c) The *fleur de lis* are part of the Spanish traditions since Medieval times, but they became more frequent since Felipe V (1700–1724), who allowed his allies to add them to their own coats of arms. It has a strong link with Christianity, and it is most frequently painted gold on blue backgrounds, as in this coat of arms.
- (d) The feathered helmet and most significantly the crown, connect further with family's knighthood and nobility, as they evidenced the family's military actions to defend the monarch.

Davila

Likewise, the Davila family's *carta* is an amended certificate in favor of the requesters: siblings Don Gomez Davila, Don Juan Davila, and Don Martin Davila, legitimate children of Don Gomez Davila and Doña Leonor de Melgarejo. The executory certificate dates from February 11, 1608, and it recounts how the Davila siblings, neighbors of Jerez de la Frontera, litigated with the local municipality to prove deserving to be *hidalgos* via the interrogation of multiple witnesses. The judgment's resolution in favor of the siblings led to this corrected document that expanded the original executory certificate of nobility emitted by the Royal Chancellery of Granada to their ancestors on December 14 of 1554.

As a surname, the Davilas can be traced back to the city of Avila in the 12th c., from where they branched out to the entire Iberian Peninsula and the Americas [30]. Two examples of their prominence are evidenced by Felipe II granting Don Diego de Avila a Marquis title, and a family member being knighted to the prestigious *Orden de Santiago*. The coat of arms in the studied *carta* (Fig. 2d) displays two crowned eagles facing each other, separated by a tree, symbols that could be used only if persons fought on behalf of the monarch [28], as with the Nuñez D. Armestos [3].

While the overall appearance matches some of the historic Davila coats of arms, it is impossible to state unequivocally that this manuscript is directly related to them. Further, having the same surname did not result in immediate connection to a family, and unless the coat of arms was inherited through direct male bloodline, a family could not copy nor use the one linked to their name. For this reason, there are multiple coats of arms associated to one surname, many of which are from different parts of Spain and not necessarily genealogically linked [28].

Construction

The Iberian Peninsula has a rich and long bookbinding tradition attested by the linear kilometers of Spanish and Portuguese archives and library that survive, but to the best of our knowledge, no formal bilingual texts on this specific history and bookbinding traditions have been internationally published/are not widely available. Executory certificates of nobility are convenient documents to broaden our understanding of illumination traditions because they were produced during a well-defined period in Spanish history. As such, we are interested in learning if there were mandatory styles or guidelines the Chancelleries, scribes, and bookbinders followed when creating them. And if not, whether bookbinding traditions followed any format or fashion.

Contrasting the Nuñez D. Armesto and Davila manuscripts offers a glimpse into three different periods: both families were recognized as *hidalgos* in the second part of the 16th c., the Davilas *carta* was amended on the 17th c. and the Nuñez D. Armestos during the 18th c. The embellished Nuñez D. Armesto versus the seemingly austere Davila's might hint at different types of manuscripts, with only the latter perhaps belonging to the Chancelleries' [8], made simply for record-keeping. The more embellished Nuñez D. Armesto *carta* seems to fit the description of a family's personal copy, as outlined in the introduction, although vellum is only used in one folio, and it is this material that most of the 50 online and 11 in-person surveyed *cartas* are made of.

The Nuñez D. Armesto family's certificate of nobility (Fig. 1) consists of a full-style tight back binding covered in red velvet with 86 folios of one type of paper as interleaving material, two types of paper as writing support (original and amended decisions, both from the 18th c.), and one vellum folio depicting two full size illustrations: one religious image and the requester's family and coat of arms (the monarch's coat of arms is on paper). The poor condition of this manuscript did not permit identification of the sewing pattern, as the necessary flexing of the gathering's gutter would likely yield to permanent damage. Raking light observations of the silk's pile indicate

that the binding had clasps that were dissociated from the binding at some point, observation further supported by the three perforations located within the clasp silhouette.

The absence of raised cords provides a smooth spine-to-board transition. The textblock was rounded, without backing, and its edges were gilded using gold, as evidenced by X-ray fluorescence (XRF). The binding has a tight back, laced-on structure with a tight joint configuration. The textblock is laced through onto to the boards with five single recessed fiber cords supports—each binding square measures approximately 3 mm.

Núñez D. Armesto's red velvet binding follows fifteenth–seventeenth century traditions as textile bindings were a symbol of power and wealth at the time [31]. Such documents increased the demand for velvet [5] because this textile was used to cover wooden or pulp boards, which were embellished with metal clasps [31], like the ones we infer this book had. Despite sounding ubiquitous then, technical studies on textile bookbindings within the field of book conservation are scant, perhaps due to their sensitive nature, as worn-out textile covers were replaced with new material, often not reminiscent of the original [32]. However, this *carta's* velvet appears to be original because silk was identified as the covering material on both pile and warp-weft, using polarized light microscopy (PLM) and Fourier transformed infrared spectroscopy (FTIR) (Additional file 1: Fig. S1).

The overall velvet pile is friable, particularly at the joints, around the spine headcaps, and board edges and corners, where the warp and weft are distinctively exposed. XRF enabled the identification of arsenic, iron, lead, and mercury throughout the velvet (Additional file 1: Fig. S1), and while we do not have an unequivocal explanation for their presence, we believe the following are three feasible hypotheses:

- (a) Pesticide application between the nineteenth and the late twentieth century [33].
- (b) Silk weighting agents, as lead, arsenic and iron salts, including acetates, were common silk mineral weighting agents [34].
- (c) Original dyeing, because kermes-dyed silk was sometimes treated in arsenic-containing dye baths and rinsed with arsenic-containing hot water mixes [35].

Even when gas chromatography coupled to mass spectrometry (GC-MS) [36] was not successful at identifying the organic colorant, (c) remains one of our hypotheses. Concerned by the presence of toxic arsenic and lead on this fragile and powdering binding, we performed pick-up quantitative analysis using cotton swabs and pads to evaluate potential users' health and safety. Fortunately,

lead and arsenic are present in only negligible amounts that are safe for handling, but users are advised to be cautious when handling materials that may have pesticide applications.

Like the Núñez D. Armesto family, the Dávila family's *carta* (Fig. 2) is also a full-style tight-back binding, but with leather over wooden boards. The leather's blind-tooled decoration consists of anthropomorphic motifs framed in a free-hand executed lattice pattern. Single anthropomorphic elements were executed with brass tools while continuous bands and the lattice panel were executed with brass rolls (Fig. 2a).

The brass anthropomorphic motifs within the lattice present irregular spacing and depth, indicating it was a free-hand composition; the lines present regular depth and overlap each other at the intersections. The same tooled anthropomorphic motifs decorate the spine piece, segmented in four parts by three raised cords. The leather is black sheepskin, based on visual examination with magnification. The textblock is rounded and slightly backed, and its edges are sprinkled with red colorant where iron, lead, and mercury (XRF) are prevalent, perhaps indicating (a combination of) iron and lead oxides, e.g., red ochre, vermilion, minium (Additional file 1: Fig. S2). Unfortunately, our Raman instrument is closed configuration and its opening was not big enough to safely handle the manuscripts to conduct this molecular analysis. The binding fastening/lacing mechanism consists of a red-pigmented fiber cord laced through the upper and lower board's leather, pastedown, and wood at the fore edge. Like in the fore edge, XRF detected iron, lead, and mercury, suggesting the presence of a similar red pigment mixture (Additional file 1: Fig. S2).

Intact but faded red and white sewn-on primary endbands with beads on the edge over a fiber core sit above the textblock's head and tail and are laced into the boards. The textblock is sewn all-along on three single raised cords. Neither the upper or lower board have been back-cornered or shaped.

Text block

Though no inventory exists listing every *carta ejecutoria* issued by the *Chancillerías*, paleographer and diplomat Elisa Ruiz García observes that *cartas ejecutorias* were bound manuscripts of more than fifty pages [4], like the majority of manuscripts we have surveyed both online (if digitized) and in-person—the number of surviving *cartas* is probably at least in the hundreds. The two detailed cases presented here consist of folios of hand-made laid rag paper, handwritten by the tribunal's scribe(s), sewn into a textblock, and custom-bound—this helps explain why we have identified so many binding styles. As mentioned in the introduction, a copy was to be kept with the

rest of the certificates of the nobility, and the other was safeguarded by the—now noble—family [8]. Of note, the majority of the manuscripts we have studied and are the subject of ongoing research, are written in vellum, bound on leather, and decorated with blind or gold anthropomorphic tooled designs.

Seals

Certificates of nobility feature a lead seal hanging from colored threads [8] as stated on folio 86 of the Nuñez D. Armesto family's *carta* (Fig. 5a):

[...] *escrita en papel, sellada con nuestro sello de plomo, pendiente de un cordon de seda de diferentes colores [...]*

Approximate translation: [...] “written in paper, and sealed with our lead seal, hanging from a multi-colored silk thread” [...].

Adding a seal validates a *pleito's* outcome: a lead seal implied eternity, as stipulated by Alfonso X *el Sabio*, who also believed that wax seals had a temporary status [24]. Unfortunately, the earliest results of our survey suggest that most lead seals have been lost, including Nuñez D. Armesto's family.

Nuñez D. Armesto's *carta* exhibits an additional type of seal: the first and last folios of the first *pleito*, finalized in 1792, are stamped with the *Carolus IV Hispania Rex* seal, Carlos IV's coat of arms (Figs. 3a, b; 5a). The same seal is repeated in every folio of the amended portion, next to a second stamp that states this seal costed *veinte* (twenty) *maravedís*, and the year that the transaction took place: *mil setecientos noventa y tres* or 1793 (Fig. 3c, d). Like much of present-day legal documents, seals were used to execute legal documents that were granting some privilege, as *hidalgua de sangre* was. This practice was established during Felipe IV and aimed to increase the monarch's income to finance its multiple war efforts [37].

Dávila's *carta* still shows an intact wax seal (Fig. 5b), which in the above-mentioned context would put this document's verdict on a potentially temporary status. However, this style of seal—*sello monofaz y con contrasello heráldico*—was common during Fernando II de Aragón (1474–1504) and became frequently used since 1519 with Carlos I and during the Habsburgs (1516–1700), as shown in the Alonso Alvarez de Toledo's *carta* (Fig. 5c) [38]. The seal in Davila's *carta* contains lions, castles, and a crown with adornments reminiscent of *fleur the lis*, elements present in the coat of arms that Spanish monarchs used between 1580 and 1668, fitting the time period in which this document was sealed. Infrared photography of this wax seal did not reveal any additional information (Fig. 5d).

Seals like the ones shown in Fig. 5b and c were created by laying hot wax on the paper support covering it with more paper and stamping the seal on the top paper to create an image in relief.

Dávila's nobility status was conferred in 1554 (“*mil y quinientos y cincuenta y cuatro*”), which is interesting because the beginning of the text states the *pleito* began in 1608, *mil y seiscientos y ocho*. Reading the full text falls out of the scope of this project stage but doing so would enable deeper understanding of this legal document, as well as those contained in similar manuscripts—we have found at least two other manuscripts with seemingly similar discrepancies.

Cellulosic writing supports

Naked-eye examination of the Nuñez D. Armesto family's textblock, combined with XRF analysis, paper caliper measurements, and watermark identification confirmed the existence of three papers of different provenance, all used in the eighteenth century:

- Paper MALLO (Fig. 6a). XRF showed the presence of mostly calcium and sulfur, much like most of the contemporary rag paper. It is a lightweight blank single sheet of laid Spanish paper that interleaves the king's coat of arms. Its watermark reads “MALLO”, and corresponds to Alonso Mallo, from Oviedo who had a paper mill in Valladolid [39].
- Paper J KOOL (Fig. 6b). In addition to calcium and sulfur, XRF revealed this paper also has arsenic, nickel, and cobalt. Its watermark consists of a

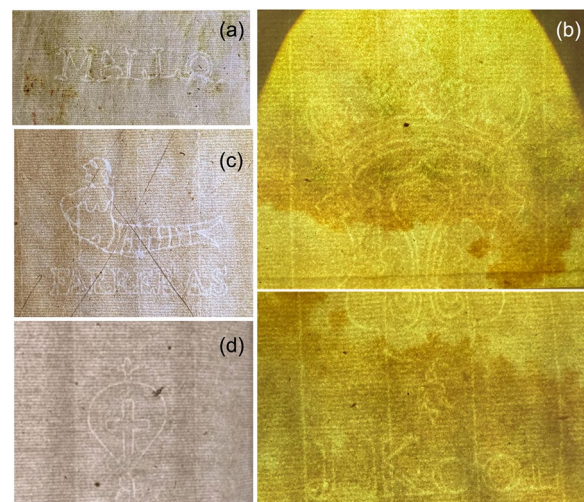


Fig. 6 Watermarks in Nuñez D. Armesto's *carta*: **a** MALLO, **b** J KOOL, and **c** Farreras. And in Davila's *carta*: **d** Latin cross inscribed in a heart with illegible letter at the bottom (Photo credit: VMO)

crowned shield and a lily flower with "J KOOL" at its feet. This paper represents the bulk of the textblock and is adjudged to Jan Kool, whose papers were used in Holland, Germany, and Spain [40, 41].

- (c) Paper Farreras (Fig. 6c). The last gathering consists of paper with the same elemental profile as MALLO, and it is written by multiple scribes and notaries. This paper can be attributed to Francesc Farreras, a Spanish papermaker with a mill located in Capellades, Barcelona, Spain. His watermark is that of a mermaid with "Farreras" at the bottom [42].

Arsenic, cobalt, and nickel in J KOOL are diagnostic of smalt, a high-quality paper additive first used by Dutch papermakers to counteract the expected age-related yellowing of linen and hemp [43]. The principal source of cobalt used for obtaining this glass was the mineral skutterdite: $(\text{Co}, \text{Ni})\text{As}_{3-x}$ [44]. This paper was used in most of the document, thus associating its the most important part with the best quality paper. Papers Farreras and J KOOL were collated together and sewn in one campaign, evidenced by the gilded decoration found on the textblock's edges, where XRF showed gold and lead, in addition to the elements mentioned above.

Paper MALLO was used as interleaving over the coat of arms and suggests this is an addendum because it was a tipped over the illumination. Addenda were especially common during Felipe II *el Prudente* (1556–1598) because of high volume of certificates of nobility applications every time there was a new family member claiming nobility—the original practice was to re-write the entire document [9]. The original Nuñez D. Armesto's certificate might point to a continuous practice since Felipe II, as the original textblock is dated 1582 with a 1773 addendum, coinciding with Felipe II and Carlos III *el Político* (1759–1788), respectively.

Dávila *carta's* endpapers are fine white, laid, blank folios sewn all along, consisting of the pastedown, its conjugated fly-leaf, and a tipped in fly-leaf. Its textblock consists of unnumbered folios where the text was handwritten in cursive using metallogalic inks and historiated letters discussed on Section "Illuminations and iconography". Caliper measurements of paper reveal that the thickness of the paper within the textblock averages to 0.39 mm. Under transmitted light, the pages reveal a watermark that consistently appears throughout the textblock—a Latin cross centered in a heart or drop (Fig. 6d). The papermaker associated with this watermark is unknown, but its use in seventeenth-century Italy and Spain signals evidence of European paper trade [45].

Writing inks

Nuñez D. Armesto's main document has multiple visually distinct inks that correspond to many hands and exhibit a range of signs of decay, although the elemental profile XRF showed was fairly homogeneous, with stronger X-ray lines for iron; and weaker lines for zinc, calcium, and arsenic in all measured spots. Both the elemental profile and damage present on the J KOOL's paper are homogeneous, suggesting the modest signs of degradation are attributed to scribes using a similar, well-balanced ink recipe, along with a well manufactured, low-lignin containing, paper (Additional file 1: Fig. S3). UV photography showed the mild green fluorescing halo associated with stage 2 degradation patterns [46] that when applied to high-quality papers like J KOOL yield to the observed minimal damage, i.e., no ink dropouts or cracks.

In contrast to the homogeneous elemental profile of inks on J KOOL paper, XRF of inks on the Farreras paper showed mostly iron and copper-containing inks, with a wide range of brown tonalities visually associated with the multiple hands signing the *carta* between 1793 and 1800 (Fig. 3c). The paper's poorly sized properties have enabled its unbalanced copper and iron-rich inks to sink into the paper, presenting stage 3 degradation patterns, evident with both the naked eye and UV photography (Fig. 3d) as they show the characteristic iron and copper-catalyzed oxidation of cellulose [46].

The Dávila's *carta* has multiple metallogalic inks, many of which tested positive to Fe (II) ions using the bathophenanthroline indicator paper [47], explaining the significant dropouts throughout the textblock, historiated letters included.

Both manuscripts use cursive handwriting, contrasting to previous reports [9] and most of those we have examined that use round gothic lettering, e.g., Fig. 4b and c. This general observation may be indicative of personal style preference more than needing to follow a given format, a hypothesis that is yet to be tested.

Illuminations and iconography

The Nuñez D. Armesto family's certificate has multiple colorful historiated letters (Fig. 1b) as well as three full-page illuminations consisting of the *Inmaculada Concepción de María* (Virgin of the Immaculate Conception) (Fig. 7a, left), the coats of arms of the Nuñez D. Armesto (Fig. 7a, right), and the then reigning monarch, Carlos IV (1748–1819) (Fig. 7b): the first two in parchment, and the monarch's coat of arms on paper. Table 1 shows the pigments identified using a combination of fiber optics reflectance spectroscopy (FORS) and XRF.

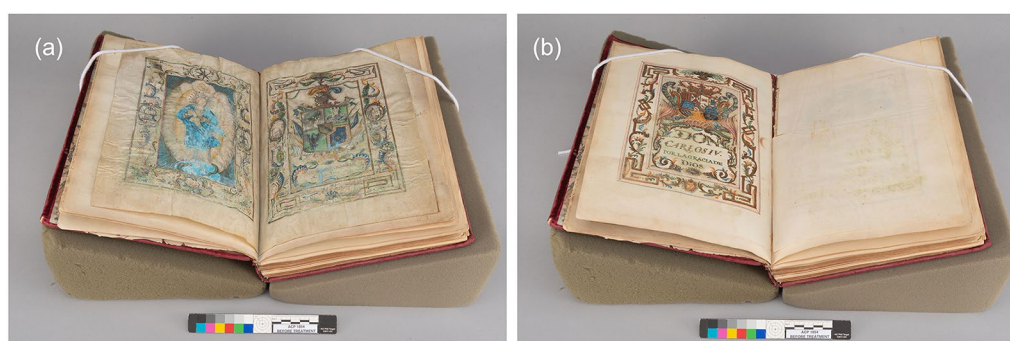


Fig. 7 Full-page illuminations on Nuñez D. Armesto's *carta*: **a** Immaculate Conception of Mary (left) and family's coat of arms (right), both on parchment; **b** Carlos IV's coat of arms on paper. (Photo credit: J. Schenck)

Table 1 Summary of coloring materials present on illuminations of Nuñez D. Armesto and Davila family's *cartas ejecutorias de hidalguía*

	Family				
		Nuñez D. Armesto*		Davila*	
	Virgin	Family's coat of arms	Monarch's coat of arms	Family's coat of arms	Monarch's coat of arms
White lead	✓	✓	✓	✓	
Azurite	✓	✓	✓	✓	
Ultramarine	✓	✓	✓	✓	
Verdigris			✓		
Malachite	✓	✓		✓	
Lead-tin yellow		TBC	TBC		
Yellow ochre	TBC				
Yellow lake	TBC			TBC	
Mosaic gold		TBC	TBC		
Red lead				TBC	TBC
Red lake				TBC	
Brass	✓	✓	✓		
Gold				✓	✓
Silver					✓

*TBC—Gathered spectroscopic information suggested its presence but needs complementary analysis to confirm

TBC = to be confirmed using molecular analysis, e.g., Raman spectroscopy

Executory certificates were valuable for their legal content and the persons and institutions that signed them off. Embellishing legal documents was central during the *Antiguo Régimen*, as symbolism enabled highlighting certain people's privileged position [1]. Examples include finding depictions of the Virgin Mary in multiple *cartas*, including in Nuñez D. Armesto's

(Fig. 7a) and Rodrigo Calera's (Fig. 4a), the latter even including a group praying, possibly the family.

Depictions of Mary vary although her main attributes (e.g., a blue mantle) are omnipresent in all, the dogma of the Immaculate Conception of Mary's being just one. The Immaculate Conception of Mary is the patron of Spain since 1760, during the Carlos III monarchy, so finding her

image on a certificate of nobility issued during Carlos IV *el Cazador* attests to the importance of validating a person's pure blood in a religious context: to be worthy of noble status, a family needed to prove they were faithful Catholics.

Other frequent images are a crucified Jesus Christ and most notably *Santiago Matamoros*, known also as *Santiago el Mayor*, and in English as Saint James, the Moor-slayer. This *Santiago* is a beacon to Christianity, and he is represented riding a white horse, wielding a sword, and wearing helmet and armor [3]. He is credited with spearheading and defending Christianity in Spain, inspired by the stories written in the Golden Legend, a book that captures the stories—histories—of early-Christianity saints, who defeated Pharisees (described similarly to present-day Jews) and Moors (described similarly to present-day Muslims), and frequently died tortured defending their faith [48], signaling clear opposition to non-Christian beliefs (Fig. 8).

XRF analysis on the Virgin's blue mantle showed weak lines for lead, and very strong lines for copper, suggesting the presence of a both lead- and copper-containing pigments. FORS showed reflectance at 485 nm, a broad absorption at 621 nm, a shoulder around 730 nm, rise in reflectance around 900 nm, absorbance at 1493 nm, and hydroxyl features at 2285 and 2355 nm indicating the presence of azurite, a basic copper carbonate [21, 49–52]. Azurite is likely mixed with ultramarine, given the shift of ultramarine from the reported 466–485 nm—the shift can be attributed to the white pigment basic lead carbonate, as inferred from XRF (Fig. 9) [50].

The evidence gathered from the blues on both Nuñez D. Armesto's and Carlos IV coats of arms suggested the blues include ultramarine as well, with a reflectance peak at 472 nm, followed by a broad absorption at 644 nm, and rising its reflectance again at approximately 730 nm

[49, 50]. Since XRF spectra in both coats of arms showed strong lines for both lead and copper and there is a shift in the ultramarine reflectance band from 466 to 472 nm, it seems plausible that ultramarine was mixed with azurite perhaps to use less of the costly pigment [50]; and lead white possibly to accelerate the drying process thus preventing cracks [53]. Further non-sampling confirmatory analyses (e.g., Raman) desirable to confirm such observations was impossible to do.

Finding ultramarine on both coats of arms of this *carta* in addition to Mary's depiction is in a way defiant to what is published about ultramarine's traditional use [21, 54]. Until recently [50], this pigment had been found only on important features like depictions of Christ and the Virgin on illuminated manuscripts produced between the fourteenth and fifteenth centuries [44].

The Virgin's hair, her mandorla, and the dove of the mandorla showed strong XRF lines for calcium, followed by weaker lines for iron and manganese. In addition, her hair had mercury, copper, and zinc, suggesting brass was applied as a mercury amalgam to achieve the fine lines that make up the hair's strand effect on either a yellow lake pigment, or an ochre. The presence of iron and manganese makes an ochre more plausible, and while complementary FORS analysis showed a gradual reflectance increase in the near infrared region, unfortunately it did not show a clear broad peak around 580 nm (brown ochre), nor broad absorptions centered near 630 or 900 nm (yellow ochre), so it is unclear which of the two pigments inferred using XRF was used [49].

XRF showed strong lines for copper in the Immaculate Conception's serpent, as well as in features in both Nuñez D. Armesto's, and Carlos IV's coats of arms (Additional file 1: Fig. S4). Complementary FORS analysis revealed that verdigris is present on two elements of the monarch's coat of arms: green stone decorations on the crown, and



Fig. 8 Images of *Santiago de Matamoros* (James the Moor-slayer) in two *cartas ejecutorias de hidalguía*, many of which include crude depictions of slaughtered people wearing turbans: **a** *Rodrigo Caldera vecino de Villarrobledo* (OCLC: 1281575299), and **b** *Alonso Gaytán de Cuenca Truxillo vecino de Xerez d' Frontera* (OCLC: 696016861). Photo credits: Kislak Center for Special Collections, Rare Books and Manuscripts, University of Pennsylvania

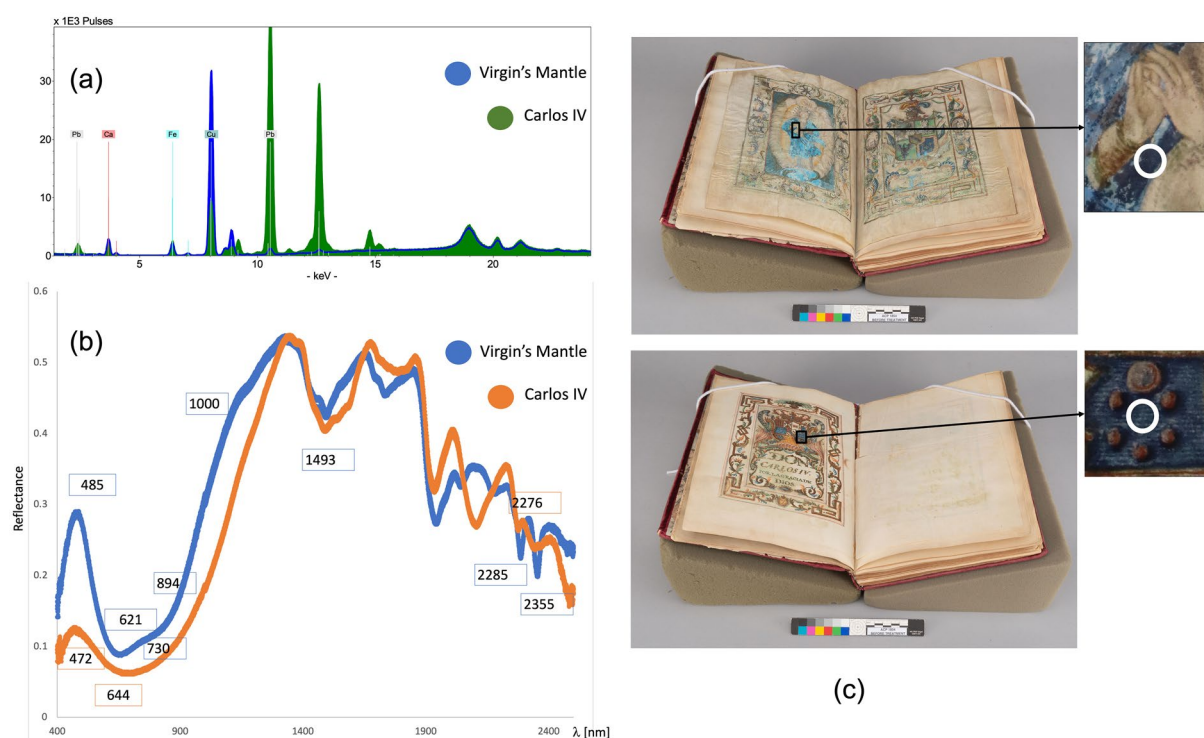


Fig. 9 Blue pigments present in full-size illustrations of Nuñez D. Armesto's *carta*. **a** XRF spectra on the Virgin's mantle (blue); and Carlos IV's coat of arms, both showing calcium, copper, and lead lines. **b** FORS spectra on the Virgin's mantle (blue) and Carlos IV (orange). **c** Details of areas that were analyzed with both XRF and FORS. (Photo credit: J. Schenck)

the leaves surrounding it (steep slope 1000–1850 nm, and absorption 720 nm). In contrast, both green quadrants on Nuñez D. Armesto's coat of arms and the serpent on the Virgin's illumination seem to be malachite (absorption bands 2200–2500 nm, carbonate overtones at 2290 and 2350 nm) [49–52, 54, 55].

Tin-, lead-, and brass (copper and zinc)-gilded motifs were found on the monarch's and Nuñez D. Armesto's crowns, Nuñez D. Armesto's helmet, and the chalices decorating both illuminations (Additional file 1: Fig. S5). Naked-eye observations of the metallic features suggested gilded decorations were painted, and XRF analysis revealed copper and lead but not gold, which might indicate copper powder applied over a preparatory layer of white lead.

The presence of what could be a now-darkened lead–tin yellow on the Nuñez D. Armesto helmet's coat of arms as well as on the lion of Carlos IV's coat of arms was inferred through XRF (Pb and Sn), frequently applied as a substitute to orpiment [54]. The inflection point either at 480 or 500 nm to confirm lead tin yellow I or II was unclear using FORS [55] (Additional file 1: Fig. S5). An alternative pigment is perhaps mosaic gold, characterized by strong tin lines, especially in gilded areas like

the chalices. Unfortunately, confirmatory the 204 and 313 cm^{-1} Raman shifts could not be obtained given our Raman spectrophotometer's closed configuration where neither manuscript could fit [56].

In contrast to Nuñez D. Armesto's certificate, and most certificates of nobility we have examined, the Dávila's *carta* has no religious images. The only illustrations are the family's coat of arms (Fig. 2d) and the multiple historiated and inhabited letters (Fig. 2b, c). The combination of XRF and FORS spectroscopies showed similar pigments to Nuñez D. Armesto's *carta*, except in the case of historiated letters (Table 1), and all gilded motifs.

Both blue and green in the Davila's coat of arms are copper-containing pigments (Fig. 10), the former likely a pigment mixture with azurite; and latter likely malachite, as evinced by lines for copper (XRF), and 600–900 nm absorbance in addition to the two carbonate stretching overtones at 2806 and 2356 nm (FORS) [49, 52, 57]. FORS also showed a strong absorbance maximum at 600 nm for the blue ribbon, which may be indicative of ultramarine mixed in [55].

The red–orange ribbon with its strong XRF lines for mercury and lead may indicate a combination of red lead and vermilion [58], although no sulfur was detected.

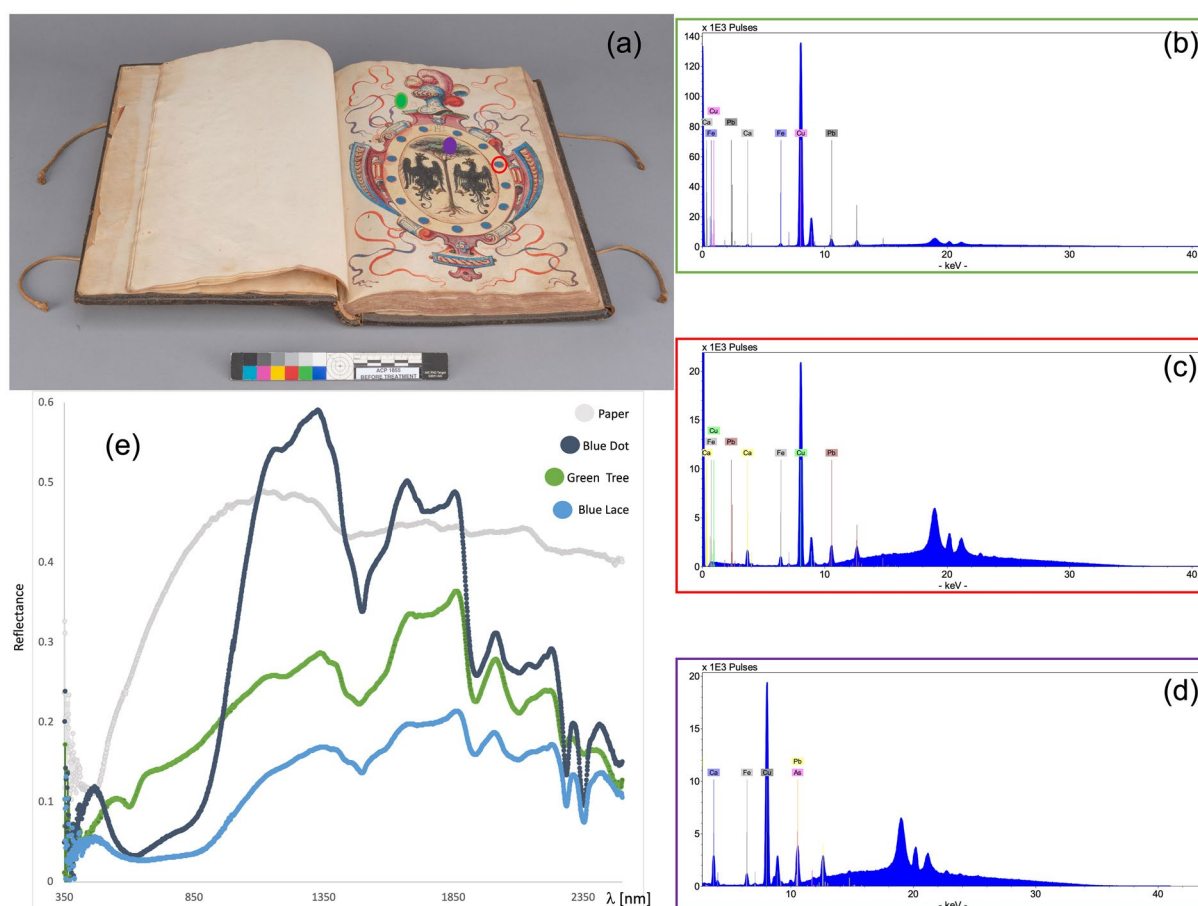


Fig. 10 Green and blue pigments present in Davila family's coat of arms. **a** Davila's *carta* open at the coat of arms page where the colored circles indicate areas measured; **b** blue on lace (green circle); **c** blue dot (red circle); **d** tree (purple circle); **e** overlay of FORS spectra. (Photo credit: J. Schenck)

The crowns are gilded using gold, which seems to have been applied as an amalgam of mercury, given the overall appearance under magnification, and that mercury was detected in the area. Yellow and purple decorations display an identical profile to that of paper (Ca, Fe, Cu) except for relatively stronger calcium lines when normalized, perhaps suggesting organic lake pigments [59]. Pinks seem to be organic lakes that were applied as washes on top of a thick layer of lead white, given the appearance under high magnification and the strong lead lines on XRF. Further, FORS showed two absorptions below 600 nm: at 562 and at 527 nm consistent with an insect-derived lake [49] (Additional file 1: Fig. S6).

The most prominent of Davila's historiated letters depicts either Felipe III *el Piadoso* (given the manuscript's date of 1608 and he reigned from 1598 to 1621), or most likely Carlos I *el César* (Fig. 2c). The greater likelihood of Carlos I being the image is because the family's great grandparents were named *hidalgos* during his reign

(1516–1556) in 1554, *pleitos* were lengthy, and the image is embedded inside the letter D that begins the sentence “Don Carlos por la divina clemencia [...]” (Don Carlos by the divine clemency [...]) To add value to the symbolism that depicting the monarch carried, XRF showed that his armory was decorated using silver, and both the gilded background and the letters OCAR (for DON CARlos) are made by applying gold. Under high magnification it is apparent that some of the applications were painted, coinciding with what Hidalgo Ogáyar states: Illuminators gilded using leaves only on large backgrounds but starting the 16th c. they preferred painting with gold dust, using a gum as a medium (there was no attempt to identify the binder) [60]. This historiated illumination is inferred to be layered on red lead, possibly minium, as evidenced by the strong lead XRF lines, coinciding with other reports on illuminated manuscripts [15, 55].

The final date on Davila's *carta* coincides with the reign of Felipe III *el Piadoso*, who led the efforts to expel

Moriscos, former Muslims converted to Christianity, from Spain. Knowing this time overlap, it is striking that this manuscript is one of the very few we have examined with no Catholic images. However, God and Jesus Christ are mentioned multiple times in the main text, for example in the same page where Carlos I (?) is depicted (see Fig. 2c's translation).

Parchment

Most of the *cartas ejecutorias de hidalguía* we have examined in the survey to date are written on parchment, in contrast to our two in-depth case studies: Nuñez D. Armesto's *carta* has parchment supports for the first two full-page illuminations, and the Dávila's *carta* has paper supports only. In addition to being made in a material that is different from many of the surveyed *cartas*, the two case studies are comparatively less embellished, perhaps signaling a purely aesthetic drive from collectors, a hypothesis that will be tested as we advance this project.

Visual examination of Nuñez D. Armesto's parchment suggested that both the Virgin and the family's coat of arms were painted over a sheepskin parchment folio. This was confirmed by peptide mass fingerprinting (PMF), where five of the ten samples provided useful results. Samples PMF.T-Virgin and PMF.U/PMF.V-Nuñez suggested the use of sheepskin (Cet1(1105), A(1196), B(1427), C(1580), D(2131), F(2883), G(3033) m/z), but sample PMF.S-Virgin did not show G(3033 m/z), the decisive marker between sheep and goat.

Only one sample (PMF.T-Virgin) matched for cattle, which sets it apart from sheepskin by only two markers: A (1208) and F(2853) m/z. Finding markers for cattle on PMF.T-Virgin was a surprise, so it is possible that the skin was subjected to cross-contamination during the skin preparation or manuscript-binding. A second hypothesis that may explain the presence of cattle is that the artist used a proteinaceous, cattle-based, coating on the Virgin's side of the folio [61]. Despite apparent incongruencies, the use of goat or sheep aligns well with the historical data because sheepskin was preferred in Northern Europe, goatskin was favored in Italy [54]; and both goats and sheep were the skin of choice in Spain [62].

The calcium and sulfur lines detected with XRF on the bare parchment evidenced aspects of its manufacturing process (Additional file 1: Fig. S7), e.g., sulfur and calcium from calcium-containing oxides, sulfates, and carbonates (CaO, CaSO₄, CaCO₃) [63]. Craftsmen prepared parchment by softening skins with slaked lime and then stretching them. The process was followed by whitening the surface with chalk powder, rubbing it into the damp skin to create a white and smooth writing surface.

Chloride and potassium might be attributed to the water used in the soaking processes, e.g., from sodium and potassium chlorides in local water. Manganese could be attributed to either water impurities, or it could be associated to its natural abundance in natural calcite [63]. Iron likely comes from processes to remove hair and polish [64], though it can be attributed to normal grime accumulations over the centuries; and lastly, finding some copper may be explained by the migration of copper-containing pigments found on the folio's illumination, such as azurite and malachite [63].

Conclusions

Spanish late fifteenth through early eighteenth centuries monarchic law used symbolism to elevate significance, for example by adding illuminated elements to verdicts. Spain is the only European country with such historical tradition and yet, both technical analyses and knowledge of Spanish illuminated manuscripts-making practices are scant. Aiming to alleviate this gap, we presented the earliest results of an ongoing survey that is deepening current understanding of illumination traditions in this Iberian country. To limit the survey, we are using *cartas ejecutorias de hidalguía* (executory certificates of nobility), as they represent a delimited and well-documented period. We discussed observations from visual examination of selected *cartas* housed at the University of Pennsylvania, and two in-depth case studies housed at the University of Delaware: Davila family and Nuñez D. Armesto family.

Cartas ejecutorias de hidalguía are the legal proceedings that gained or regained noble status to individuals or families, desirable for benefits such as tax exemptions and social standing. Since being a *hidalgo* was connected to "blood purity" and lineage, *cartas* included probatory testimony of Catholic faith. Representations of Jesus, Mary, *Santiago Matamoros* (James the Moor-slayer), etc., are common; as it is heraldry, which represented a family's merits, honors, and faith.

Our two in-depth case studies contrast three time periods, as both *cartas* were written in the second half of the sixteenth century, and Davila and Nuñez D. Armesto families had them amended in the seventeenth and eighteenth centuries, respectively. The amended portions used different materials and handwriting, with inks of different elemental profiles and papers with different watermarks. *Cartas'* illuminations include fauna, flora, and, most notably, the reigning monarch, all metaphorically playing validating roles, e.g., the king was depicted and named throughout to symbolically show that these were his—unquestionable—decisions.

Comparing the Davila's *carta* to surveyed documents, including the Nuñez D. Armesto's may suggest

this *carta* was for record-keeping only, given its apparent relative simplicity. However, when analyzing the materials used therein, we found gold on the family's coat of arms, and both gold and silver on the monarch's depiction. This perhaps indicated that either this comparatively less embellished *carta* is the family's copy, or original documents meant to remain at the Chancery for record-keeping could be also embellished. We are yet to find identical copies of other *cartas* to test whether a simpler, yet embellished copy, was kept with the proper Spanish authorities.

In terms of illuminations, writing supports and calligraphy, there seems to be no homogeneity even when published studies have indicated that families' copies were embellished, written on parchment, and using round gothic or a related calligraphy. Thus far, our online and in-person survey has identified many *cartas* with no illuminations, written on paper, and in cursive. This includes the two in-depth case studies presented, only one of which contains religious iconography: Nuñez D. Armesto. The pigments used for the family's and king's coats of arms are the same as the ones used in the Immaculate Conception of Mary's depiction (XRF and FORS), including mixtures of azurite and ultramarine.

Legal documents are in general understudied and even less so from the materials analysis point of view. Identifying constituent materials in an aesthetic, iconographic, and historical context is enabling us to better understand a period in Spanish history that greatly influenced the world, as the rule of law was shrouded in symbolism and Catholicism. The materials chosen to make *cartas ejecutorias de hidalguía* greatly resemble the well-studied European illuminated manuscript-making practice, but their symbolism and use as legal documents sets them apart. Materials seem to have been deliberately chosen to add value to families' histories, themselves represented through complex heraldic symbols that highlighted their religion, their service to the monarchy, and their nobility. It will be through more in-depth certificates of nobility's studies using a combination of instrumental analysis, conservation, and historical research that we will help contextualize better this Spanish period—a period that changed the world through customs, aesthetics, and laws that traveled to the Americas and are part of the continent's history, with all that carries.

Abbreviations

FORS	Fiber optics reflectance spectroscopy
XRF	X-ray fluorescence spectroscopy
PMF	Peptide mass fingerprinting
MALDI-ToF	Matrix assisted laser desorption ionization time-of-flight spectrometry
FTIR	Fourier transform infrared spectroscopy

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s40494-022-00850-y>.

Additional file 1: Figure S1. Red velvet bookcloth on Nuñez D. Armesto's *carta*. Above: FTIR spectra of pile (green) and Bombyx mori reference (red) with a PLM photomicrograph. Below: XRF spectrum on the velvet cover with a picture of the measured spot. **Figure S2.** XRF spectra on selected Davila's *carta* spots. (Above) red-pigmented lace used as closing mechanism, done on a zero-plate (not depicted) to ensure XRF was detecting only the elements on the closing mechanism. (Below) red-pigmented fore edge. **Figure S3.** Normalized XRF spectra on selected inks on Nuñez D. Armesto *carta*. Inks on Dutch paper with J KOOL watermark of three random pages: green (p. 11), pink (p. 66), and blue (p. 86). **Figure S4.** Green pigments present in full-size illustrations on Nuñez D. Armesto's *carta*. (a) XRF spectra on the Virgin's serpent (green); eagle area of family's coat of arms (pink); and leaves decorating Carlos IV's coat of arms (blue). (b) FORS spectra on the Virgin's serpent (grey); eagle area of family's coat of arms (orange); and leaves decorating Carlos IV's coat of arms (blue). (c) Details of areas that were analyzed with both XRF and FORS. (Photo credit: J. Schenck). **Figure S5.** XRF spectra of yellow and golden areas on Nuñez D. Armesto's *carta*: (a) gold applied over blue background on Carlos IV's coat of arms; (b) yellow area with red strokes on Carlos IV's coat of arms; (c) gold chalice in Virgin's decorations. FORS spectrum of yellow areas of Nuñez D. Armesto's coat of arms. (Photo credit: J. Schenck). **Figure S6.** Analysis of gilded areas, and both red and pink pigments present in Davila family's coat of arms. (a) Davila's *carta* open at the coat of arms page where the colored circles indicate measured areas; (b) red ribbon (grey circle); (c) crown on eagle (green circle); (d) pink feather (blue circle); (e) FORS spectrum of pink feather (blue circle). (Photo credit: J. Schenck). **Figure S7.** XRF of bare parchment on Nuñez D. Armesto's *carta*.

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Author contributions

VMO performed conservation treatment on Davila's *carta* guided by Dr. Melissa Tedone and used Nuñez D. Armesto's *carta* as her second year of science WUDPAC project, the latter supervised by JAG (WUDPAC is the acronym for Winterthur/University of Delaware Program in Art Conservation). VMO performed all bookbinding descriptions and is spearheading that research. Historical research, data collection, and survey were a combined effort. JAG spearheaded this project and was responsible for final data interpretation and edits. Both authors read and approved the final manuscript.

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The Mellon Foundation provided financial support for VMO during this research. JAG conducted this research while employed at the University of Delaware and teaching at the Winterthur/University of Delaware Program in Art Conservation (WUDPAC).

Availability of data and materials

Raw data can be shared upon request to the corresponding author.

Declarations**Competing interests**

The authors declare no competing interests.

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