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title: \**Gacha\** Lining’s Treatment Viability

subtitle: The Spanish and European Glue-Paste Adhesive Used Since the 17th Century

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abstract: A research project was carried out between 2011 and 2015 at the Complutense University of Madrid, the aim of which was to suggest improvements to guarantee future conservation of canvases lined with a glue-paste adhesive called *gacha*. We started with three objectives: documenting the origin of recipes and the different methods used for this treatment in Spain and Europe, as there is still little knowledge about this kind of lining; choosing case studies; and finally, carrying out a series of experimental tests to evaluate the performance of the basic materials in the recipes and of some variants in the textiles often used as lining supports.

short\_title: \**Gacha\** Lining’s Treatment Viability

<A-head> Introduction

The proposal to carry out a research project on glue-paste linings arose during a course on structural treatments of paintings on canvas led by Vishwa Mehra and Matteo Rossi-Doria at the Universitat Politècnica de València. The scarcity of scientific knowledge about linings carried out in the past with glue paste (in Spanish, traditionally called *a la gacha*) was exacerbated by the gradual abandoning of this procedure, now replaced by modern synthetic adhesives.

The project—entitled Materials and Methods of Glue-Paste Linings for the Reinforcement of Canvas Paintings: Documentation, Functionality, and Conservation—was a coordinated effort, carried out between 2011 and 2015 by a group of sixteen international specialists, a number of Spanish institutions, and the support of several companies.[[1]](#endnote-1) It was coordinated from Spain by the Complutense University of Madrid and funded by a grant[[2]](#endnote-2) from the Ministerio de Economía y Competitividad (MINECO).

# <A-head> The Need for Lining Through the Ages

It is evident that lining has allowed many paintings on canvas to survive into the present. Some linings are as much as three hundred years old. In Spain and most of the rest of Europe, linings were carried out since the seventeenth century on using linen cloth and glue-paste as an adhesive ([**fig. 18.1**](file:///Users/rbarth/Desktop/Finalized%20files-Conserving-Canvas--72122-to%20prep%20for%20TR/18-Calvo_clean/fig-18-1)). This procedure remained in practice until the 1990s, when synthetic adhesives came to prevail in the field of conservation. Especially in Holland and the humid Atlantic countries, glue paste was often replaced by wax resin from the nineteenth to early twentieth centuries.

In Spain, it was not only the passing of time and the lack of care that caused the poor condition of the works, but also the historical vicissitudes of the country, some of which, we now know, led to the need for numerous treatments to the paintings’ supports. For example, on Christmas Eve in 1734, a fire broke out in the Real Alcázar de Madrid, which housed the royal collections, many of which are now in the Museo del Prado. Many paintings burned, and others were in such a bad state that they had to be cut into pieces—and as a result many canvases were lined. Juan García de Miranda and Andrés de la Calleja were the first court painters put in charge of restorations. Their inventories recount the works saved, for example, Titian’s *Charles V at the Battle of Mühlberg*, which they identified as being in very bad condition ({{Barreno Sevillano 1980}}).

Between 1808 and 1814, during the Napoleonic Wars, many works were taken to Paris from different parts of Spain (Cádiz, Sevilla, Madrid) and arrived in terrible condition. Before being returned to Spain, some canvases were treated with linings in France, such as *Juan the Patrician’s Dream* by Murillo. Similarly, some paintings on panels were transferred to canvas, including among others, Raphael’s *Christ Falls on the Way to Calvary*, also known as *El Pasmo de Sicilia* ({{González Mozo and Alonso 2011}}).

During the Spanish Civil War (1936–39), the great works of art at the Museo del Prado and other areas on the front line were evacuated to avoid damage during the fighting. Despite the care with which they were packed and transported, incidents occurred that caused some canvases to tear, and they were later lined; these include Goya’s *The 2nd of May 1808 in Madrid,* also known as *La carga de los mamelucos.*

In 1828, the Sala de Restauración at the Museo del Prado was created by royal decree. Official posts of liners were set up and filled by competitive examination. The fact that there were professional specialists in lining shows that this kind of treatment was frequently being carried out. We can therefore count on a huge quantity of works lined with glue-paste in Spain, many of which are very well preserved. For example, of the forty-nine Velazquez paintings studied in the Museo del Prado, only seven (about 14%) had not been lined, and of the paintings attributed to El Greco, fifty-one were studied and only six had not been lined (about 11.7%). If we apply an average percentage of 13% to the 6,367 paintings on canvas held by the Museo del Prado at the end of 2019, we can hypothesize that more than eight hundred have not been lined, and more than five thousand could have been lined.[[3]](#endnote-3) These numbers lead us to reflect on the durability of these linings and the future conservation of all those works: which conservation conditions are the most appropriate for their preservation, and what should be done when the adhesives start aging and failing?

# <A-head> Developing the Project

Among the aims of the project was to get a better understanding of the historical glue-paste recipes and methods of applying treatments. We then proposed using a sample recipe and making models and tests that would allow us to determine their possible efficiency and the process of deterioration—that is, to study and verify the present suitability of a reinforcement treatment that evolved over more than three hundred years in Europe, especially its suitability for paintings that were treated with this adhesive previously. We know that this method presents little toxicity, employs materials similar to and compatible with most paintings on canvas, and is reversible, inexpensive, and sustainable compared with modern synthetic adhesives, which have certain advantages but also disadvantages (some plastic materials need high temperature to activate the adhesive, for example). In addition, we wanted to use the experimental results to suggest improvements and guidelines for preventive conservation and future preservation of paintings lined in this way.

The project was organized in three parts: a documentary work or study, an experimental study, and the sharing of the research as it was carried out ([**fig. 18.2**](file:///Users/rbarth/Desktop/Finalized%20files-Conserving-Canvas--72122-to%20prep%20for%20TR/18-Calvo_clean/fig-18-2), [**table 18.1**](file:///Users/rbarth/Desktop/Finalized%20files-Conserving-Canvas--72122-to%20prep%20for%20TR/18-Calvo_clean/table-18-1)).

# <A-head> Documentary Stage

For the documentary stage we consulted treatises, archival documents, and various bibliographies and sent questionnaires to various European professionals and institutions. We used two types of questionnaires: one for the cases treated in the more distant past and another for lining treatments carried out in the twentieth century. More than sixty questionnaires were sent, although the amount of information received differed greatly.

It was not easy to find all the recipes used. In some cases, old documentary information presented the ingredients in invoices, but it did not detail how they were prepared and applied. Similarly, we met with certain reticence from conservator-restorers when it came to explaining the recipes they were currently using, since many of them were personal variations developed by the professionals themselves.

## <B-head> *The Origin of the Use of \**Gacha*\*, or Glue Paste*

Knowing the materials used to prepare a canvas is essential to understanding the behavior of the lining treatment. With reference to the recipe, materials, and ingredients used in canvases in Spain, interesting research has been done (e.g., {{Gayo and Jover de Celis 2010}}), but we still have a lot to learn. For example, the presence of ashes in the preparatory layers has only recently been confirmed in paintings ({{Jover de Celis and Gayo 2014}}; {{Carò, Centeno, and Mahon 2018}}), although it appeared in recipes and treatises.

Through the documents we know that from the moment people started painting on canvas, a flour paste was used to prepare the canvas. Giorgio Vasari has written about flour with walnut oil, glue, and white lead for preparing the canvas ({{Vasari (1568) 1998|, 119}}). An anonymous Spanish manuscript from the end of the sixteenth century also mentions preparing the canvas with glue, flour, and gypsum and states that “if it were all flour, it would be better” ({{Bruquetas Galán 1998}}).

We find the same in Francisco Pacheco’s treatise from the mid-seventeenth century: “Some work with flour or mill-dust paste, cooking oil and a little honey (which you can eat even if you are not hungry); they apply a coating of this to a well-stretched canvas to cover over the pores … But experience has taught me that any paste of gypsum, flour or ash gets damp and with time rots the canvas and the painting comes out in scabs” ({{Pacheco (1638) 1990|, 481}}). And Antonio Palomino relates similar concerns in 1715, when explaining how to prepare the mixture by boiling and shaking it to avoid lumps: *gacha* paste with flour and water, honey and a little linseed oil ({{Palomino (1715) 1947|, 483}}). In some cases, the presence of flour paste has been identified by scientific analysis ({{Helwig and Daly Hartin 1999}}).

A treatise by Spaniard Vicente Poleró published in the mid-nineteenth century points to the lining of the canvas as an essential operation ({{Poleró (1853 and 1866) 2018}}). He describes the procedure: cover the paint surface with paper, and apply the adhesive to both the lining fabric mounted on a loom and to the original canvas on the back and then iron until it is completely dry. The idea was not to simply reinforce the support, but also to fix the layers of color with an impregnation of glue paste (which was surely much more compatible with the original materials than modern plastic adhesives).

Using the information gathered and the results of the questionnaire we were able to establish the different ingredients used in the recipes and their function in the mixture: thickener, adhesive, fungicide, humectant, and so forth ([**table 18.1**](file:///Users/rbarth/Desktop/Finalized%20files-Conserving-Canvas--72122-to%20prep%20for%20TR/18-Calvo_clean/table-18-1)).

In older recipes for *gacha* paste, such as those of Juan García de Miranda in 1735 ([**fig. 18.3**](file:///Users/rbarth/Desktop/Finalized%20files-Conserving-Canvas--72122-to%20prep%20for%20TR/18-Calvo_clean/fig-18-3)), we find flour (the main component of which is starch), honey, walnut oil, and *grasilla* (juniper resin). Among the ingredients of the Poleró recipe we also find garlic, glue, and linseed oil. Later formulas mention molasses, Venetian turpentine, oxgall, vinegar, Italian *colletta*, alum, flax seeds, and phenol. In Spain, wheat flour was typically used, but in France, Italy, and Portugal we find mention of rye flour. The glue used varies from strong or bone glue (called in Spanish carpenter’s glue) to hide or rabbit-skin glue. And more recent recipes add Plextol B 500 as an adhesive and plasticizer.

María Luisa Gómez has noted several characteristics of lining with *gacha* paste ({{Gómez 1998}}), for example that “there is no change in color, or only very slight change. Also, that the high moisture content allows for the smoothing out of cracks. However, the mixture is very hygroscopic and sensitive to humidity. There is a risk that the original canvas will shrink. There is a danger of fungal growth. Adhesion reduces rapidly in bad weather conditions, and it becomes hard and fragile. It has an acid pH. It requires the applying of heat.”[[4]](#endnote-4) She thought that the use of Venetian turpentine and other resins was not justified because they were insoluble in water, darkened, and became more fragile, and therefore suggested simplified recipes made up of only starch and animal glue with a few drops of fungicide, and that they be applied cold and used only for lining in dry climates.

## <B-head> *Case Studies*

For some cases of lined works, we were able to find references to the date and to the restorers who carried out the treatment, and we were even able to analyze the *gacha* adhesive present in them, such as those analyzed by María Dolores Gayo at the Museo del Prado, those in the Instituto del Patrimonio Cultural de España, and Ribera’s *Crucified* *Christ*, analyzed by Andrés Sánchez Ledesma (Arte-Lab S.L.) ({{Diputación Foral de Álava 2018}}). Analyses of the *gacha* are complex because sometimes it is difficult to determine the exact composition. Apart from the difficulty of accessing representative samples, they are possibly not very homogeneous adhesives, and the quantities of certain additives were too small to be identified. We should also bear in mind other treatments and products applied to the paintings over the years, which may interfere in the analytical results.

Examples of case studies include:

* Ribera’s *Crucified Christ*, in the Diputación Foral de Álava.
* Perovani’s *Portrait of George Washington*, in the Real Academia de Bellas Artes de San Fernando in Madrid, which was lined by Tomás Pérez, restorer at the Museo del Prado, in 1955 ([**fig. 18.4**](file:///Users/rbarth/Desktop/Finalized%20files-Conserving-Canvas--72122-to%20prep%20for%20TR/18-Calvo_clean/fig-18-4)). For this painting, we also were able to locate the original 1955 gacha recipe, and to examine the state of the lining via cross sections ([**fig. 18.5**](file:///Users/rbarth/Desktop/Finalized%20files-Conserving-Canvas--72122-to%20prep%20for%20TR/18-Calvo_clean/fig-18-5)).
* Murillo’s *Juan the Patrician’s Dream*, in the Museo del Prado.[[5]](#endnote-5)
* *The Spinners* and *Philip III on horseback* by Velázquez, in the Museo del Prado.

Both of the latter paintings have additional canvas strips to widen them. We know that *The Spinners* was lined 1785 by Jacinto Gómez, and perhaps he carried out the widening of the painting, although the painting’s measurements vary from one inventory to another at different periods, probably due to adaptations for specific locations. During the last intervention on the painting, many repaints were detected, covering damage that may have arisen from shrinkage when using a new close-weft canvas or been caused by burns during ironing ({{Macarrón, Calvo, and Gil 2017}}).

## <B-head> *Creating the Database*

For the documentary study, we gathered recipes, materials, and tools used for *gacha* linings. We collected invoices for products bought for lining and as much data referring to these as we could find, such as the restorer’s signature on the back of some canvases. Thus, in the Royal Palace we found an order for materials bearing painter-restorer Juan García de Miranda’s signature from 1735, in which the materials for the lining are listed ({{Macarrón, Calvo, and Gil 2013}}).

We also collected analyses and studies carried out in the collaborating institutions for certain selected case studies, according to their characteristics. All this information was stored in a Microsoft Access database, divided into several sections:

* A general catalogue of works—paintings on canvas with lining and interventions
* Recipes, treatises, and other documentary sources
* Appendices: records of restorers, work tools, ingredients in the recipes, glossary

The version of the Access software we used allowed us to filter by countries and dates, as well as by the ingredients, tools, and materials used. However, the amount of information gathered in Spain was much larger than that from other European countries taking part in the project. Likewise, the amount and kind of data gathered in the case studies were not comparable due to the different information gleaned: analysis, recipes, methods, and restorers.

# <A-head> Experimental Stage

Following in the wake of other experimental studies ({{Daly Hartin et al. 2011}}), we decided to start a scientific study of the materials of a glue-paste lining, starting with the basic ingredients: flour, glue, and cloth. Thus, a number of tests and mock-ups were carried out to assess the behavior of the lining.

We used an animal glue chosen from previous tests because of its bloom strength of 240–250. Four types of flour with differing protein content were used: two kinds of finely ground white wheat flour (different brands), coarse-ground semi–whole wheat flour, and coarse-ground semi–whole rye flour. Two kinds of linen fabric were also used: open and closed weft.[[6]](#endnote-6) The adhesive was prepared at the Universitat Politècnica de València, adhesive films were made for analysis, and the linings were carried out. Some of the samples were placed on stretchers and some were not.

The samples were sent to the Centre Interdiciplinaire de Conservation et de Restauration du Patrimoine (CICRP) in Marseilles for accelerated aging and study of susceptibility to biodeterioration (estimate of mold growth and pest infestation). They were also sent to Valencia (for morphological studies using optical and scanning electron microscope [SEM]), Copenhagen (examination of cross sections of mock-ups with optical microscopy [OM] and tensile and peel tests), and Maastricht (investigation of cracking using reflectance transformation imaging [RTI]). Members of the research team who specialized in the different techniques worked in each of these places. Some of the samples were studied before and after artificial aging: we measured viscosity and pH, used Fourier transform infrared spectroscopy (FTIR) for the characterization of the original materials and lining adhesives, and carried out morphological analysis using OM, SEM, and RTI. We also carried out tests of mechanical traction performance and peeling.

The partial results of these tests included chemical characterization, morphological analysis, studies on mechanical behavior, and biodeterioration ({{Fuster-López et. al 2017}}).

# <A-head> Dissemination

The third phase of the project was to share the work by disseminating it widely so as to familiarize professionals with this kind of canvas lined with glue-paste. The first objectives of the project were shown in the Museo Thyssen-Bornemisza in Madrid, in 2012, along with the state of knowledge on the subject at that time.[[7]](#endnote-7)

In 2012, we also presented a poster to the TechnoHeritage Congress and published some of the documentary work ({{Macarrón, Calvo, and Gil 2013}}). The following year, at Lo Stato dell’Arte 11, Matteo Rossi-Doria presented a paper on the critical recovery of traditional lining methods ({{Rossi-Doria 2013}}). In a similar context, an article was published comparing the lining systems used in Portugal and Spain ({{Calvo, Maltieira, and Barbosa 2014}}).

In 2014, we put forward some case studies in the Association des Restaurateurs d’Art et d’Archéologie de Formation Universitaire (ARAAFU) Colloquium in Paris ({{Macarrón, Calvo, and Gil 2014}}; {{Macarrón, Calvo, Gil 2017}}). That same year we also produced a poster for the Art Technological Source Research working group’s congress at ICOM-CC in Amsterdam, whose contents we published in 2016 ({{Macarrón, Calvo, and Gil 2015}}).

The partial results of the experimental section were presented and published at the ICOM-CC in Copenhagen in 2017 (Fuster-López et. al 2017}}).

In 2018 we presented a summary of the project at the II Colloquium in Lisbon: Investigación en Conservación del Patrimonio (Heritage Conservation Research) ({{Macarrón, Calvo, and Gil 2018}}). More recently, in June 2019, the four authors of this essay organized and taught a workshop at the Complutense University of Madrid, Applications of Traditional and Modern Lining Methods, with the assistance of museum professionals, private practitioners, and students ([**fig. 18.6**](file:///Users/rbarth/Desktop/Finalized%20files-Conserving-Canvas--72122-to%20prep%20for%20TR/18-Calvo_clean/fig-18-6)). During the workshop, a wide range of adhesive formulations were tested on facsimiles. Thanks to the Avangrid Foundation grant, Ana Calvo and Julia Betancor were able to present this research during the Conserving Canvas Symposium at Yale University in October 2019.

# <A-head> Conclusions

In certain historic cases, we found linings with glue paste that had changed and completely lost its adhesiveness, which led to its removal. We also found that there are now new alternatives and methodologies for structural treatment of paintings on canvas (such as strip lining, tear mending, and suction tables), but importantly, there are also new criteria as regards structural canvas treatments. This should not, however, justify a loss of understanding and knowledge of linings with glue paste.

Thanks to the project described in this essay, we have learned that hundreds of paintings in Spain are lined with glue paste—some three centuries ago and others more recently. Most are in good condition. However, more information is needed about works lined *a la gacha*: the recipes and application methods used and the environmental conditions of conservation.

In experimental studies ({{Fuster-López et. al 2017}}) we discovered variables in biodegradation, which depends on the fineness of the flour, the proportions of flour and glue, and the kind of starch and protein when the proportion of flour to glue is constant. *Gacha* recipes with semiwhole flour are more likely to biodeteriorate than those made with finely milled white flours, and the protein content of the cereal used affects the degradation process. Regarding the mechanical and dimensional stability of linings with glue paste, we found differences related to the kind of flour used, the degree of milling or grinding, and the thickness of the weft in the canvas used for lining. This suggests that conservation strategies for the long-term care of lined paintings must be carefully assessed, taking into consideration the kind of flour used in the adhesive.

It would be useful to continue testing to determine the different additives in the traditional recipes (garlic, oxgall, Venetian turpentine, disinfectants) to understand the role these products played in the lining and their effects. But on the basis of our findings and in the light of the current condition of works lined *a la gacha*, we must raise the following questions:

* Might a version of this adhesive be appropriate nowadays?
* Could it be used as a cold, or almost cold, contact adhesive?
* Might it be advisable for cases where fixing paint layers is necessary?
* Which are the most appropriate conservation conditions for works lined in this way?
* Might it be an alternative for the necessary relining of paintings that already have this kind of adhesive?

# <A-head> Notes

1. The main researcher on the project was Ana Macarrón and the following were part of the team: Ana Calvo, who started out as a member of the School of Arts at the Universidade Católica Portuguesa and then moved on to the Complutense University of Madrid, Spain; Rita Gil, technical support for the project at the UCM and co-author of the database; Laura Fuster, Sofía Vicente and Dolores Yusá from the Universitat Politècnica de València, Spain; Matteo Rossi-Doria, in private practice in Italy; Cecil K. Andersen and Mikkel Scharff from the KADK School of Conservation in Copenhagen, Denmark; Kate Seymour from the Stiching Restauratie Atelier Limburg (SRAL), Maastricht, Netherlands; Nicolas Bouillon and Fabien Forher from the Centre Interdiciplinaire de Conservation et de Restauration du Patrimoine (CICRP) Marseilles, France; Aurelia Chevalier, in private practice in France; Paul Ackroyd from the National Gallery, London; Joan Reifsnayder from ICOM-CC; and Marion Mecklenburg from the Smithsonian Institution. Spanish institutions that took part as contributors are Museo del Prado, Patrimonio Nacional, Museo Thyssen-Bornemisza, Instituto del Patrimonio Cultural de España (IPCE), Real Academia de Bellas Artes de San Fernando, Diputación Foral de Álava. Funding was provided by CTS Spain, SIT Spain, PC Conservation Products Spain, and canvas manufacturer Claessens in Belgium. [↑](#endnote-ref-1)
2. I+D+i HAR 2011-24217. [↑](#endnote-ref-2)
3. Personal communications with Laura Alba and Jaime García-Maiquez. [↑](#endnote-ref-3)
4. “No hay cambios de color o son muy ligeros. Su elevado contenido en humedad permite aplanar ciertos cuarteados. Sin embargo, la mezcla es muy higroscópica y sensible a la humedad. Existe riesgo de encogimiento de la tela original. Presenta peligro de crecimiento de hongos. Su adhesividad disminuye rápidamente en malas condiciones climáticas, y se hace dura y frágil. Tiene un pH ácido. Requiere aplicación de calor” ({{Gómez 1998|, 386}}). [↑](#endnote-ref-4)
5. We would like to thank the conservator-restorer of the Museo del Prado, María Álvarez Garcillán, for all the information she provided us on the condition of this painting. [↑](#endnote-ref-5)
6. For details of all materials see {{Fuster-López et al. 2017}}. [↑](#endnote-ref-6)
7. “Reinforcement Treatments of Canvas Paintings: Studio Cases, Evolution and Behavior,” Seminar presented at Universidad Complutense de Madrid y Museo Thyssen-Bornemisza, October 15, 2012. [↑](#endnote-ref-7)