CHAPTER 40 Making glue from parchment

Se quixeres fazer cola

Figure 1 *Main steps in the making of parchment glue.*

'If you wish to make glue, take two pieces of parchment and wash them very well, and then place them in a new [old] pot, and heat them vigorously until they are well boiled. And once the first water has disappeared, add more water into it, and as soon as you wish to try [it], take a little of it and place it in your palm. And place one hand with the other, and if your hands grip, it must be that your glue is well made.' [1].

Reproduction

A 9x9 cm square of parchment are washed with water. Afterwards, it is cut into small pieces (0.5 x 0.5 cm).

The small pieces of parchment are then placed on a beaker, covered with water (c.a. 50 ml), and heated at ca. 80º C. For this, the beaker is covered and coated with aluminium foil to promote a homogeneous heating.

After the water begins to boil, the glass container is uncovered to allow evaporation of the water and then more water is added, as suggested in the recipe, to optimise the collagen extraction. Once again it is covered and after boiling, uncovered to concentrate the glue. At this point, the glue consistency is tested as described in the recipe by emerging a stainless steel spatula in the solution and then touching the surface with the fingers to see if it grips. To finish, the pieces of parchment are removed and parchment glue is decanted into a glass container. The glue should be kept at lower temperatures (*i.e.* in a refrigerator). And whenever needed, it should be gently heated (40-50º C) so that it will become liquid again and ready to use as a binder media.

Rationalisation / Chemical reactions

Parchment is made from animal skins, mainly from calf, sheep or goat [2]. Collagen is the main fibrous protein in the dermis of the animal skin. When partially hydrolysed, it gives gelatine and the adhesive quality to the skin glue [3].

Three-protein chains that are helically wind to each other, in a triple helix, compose collagen. These chains are made by repeated units of amino acids that are strongly linked between them by hydrogen bridges. These structures provide stability and rigidity to the matrix, like a rope; juxtaposed, they form microfibrils, that group into one fibril. These, in turn, gather into bundles or lamellae generating collagen fibres. Thus, the fibres are organised in a two-dimensional network, randomly oriented, which confer tensile strength in all directions. It is through this complex network of microfibrils, fibrils and collagen fibres of the skin matrix that the parchment is sustained [3-7].

However, when heated, these chains start to unfold as consequence of the collagen denaturation; chain scission is also promoted by heating. The shorter chain proteins, after cooling, begin re-linking between them, forming new hydrogen bridges that will compose a new two-dimensional composition, amorphous – the gelatine – with the ability to be well dispersed in aqueous solutions [3-4, 7].

Key aspects

Heating temperature usually temperatures around 70-80º C are adequate to extract collagen from parchment. To promote chain scission and gelatine formation, the water boiling temperature worked well in our reproductions.

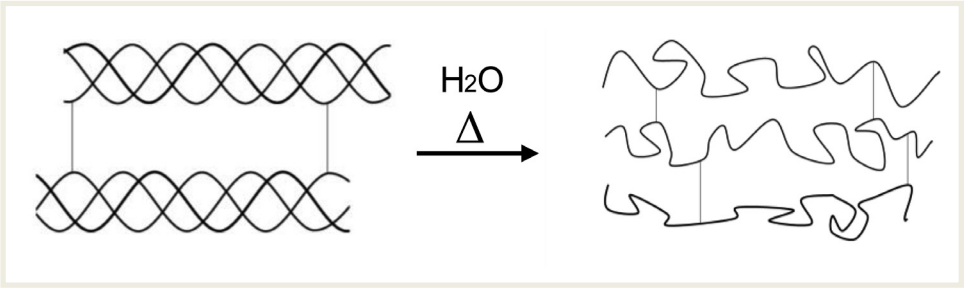

Figure 2 *Reaction scheme for collagen denaturation.*

Missing / Obscure indications

The point at which the heating can be stopped is not evident on the recipe (it only refers to keep it until 'your hands grip'). However, this is an important information since this provides a direct control on the production of a 'strong glue', meaning a well-concentrated collagen-based glue.

Comments

This recipe can be also found in Ceninno Ceninni's treatise. There are no major differences between them, although in *Il libro dell'arte* the descriptions are more detailed, such as, in leaving the parchment soaking a whole day, after boiling; reducing the boiling water up to 1/3 or using the glue for 'gessoing panels or ancones' [8].

Parchment glue in Portuguese medieval illuminations

Our research has found that the main binder used in Portuguese illuminated manuscripts was a proteinaceous one. This includes parchment glue and/or egg white, which have very similar fingerprints in the infrared analysis [9].

Works cited

[1] Strolovitch, D. L. 2010. 'O libro de komo se fazen as kores das tintas todas (Translation)', in L.U. Afonso (ed.), *The Materials of the Image. As Matérias da Imagem*. Lisboa: Campo da Comunicação, p. 235.

[2] Alarcão, A. 1986. *Pele, pergaminho e restauro*, Lisboa: Escola Superior de Conservação e Restauro.

[3] Florian, M.E. 2007. *Protein Facts – Fibrous proteins in cultural and natural history artifacts*. London: Archetype Publications.

[4] Kennedy, C.J., Wess, T.J. 2003. 'The Structure of Collagen within Parchment: A Review', *Restaurator*, 24(2): 61-80.

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[6] Badea, E., Della Gatta, G., Usacheva, T. 2012. 'Effects of temperature and relative humidity on fibrillar collagen in parchment: A micro differential scanning calorimetry (micro DSC) study', *Polymer Degradation and Stability*, 97: 346-353.

[7] Badea, E., Della Gatta, G., Budrugeac, P. 2011. 'Characterisation and evaluation of the environmental impact on historical parchments by differential scanning calorimetry', *Journal of Thermal Analysis Calorimetry*, 104: 495-506.

[8] Cennini, C. 1960. The Craftsman's Handbook – *The Italian 'Il libro dell'arte*', translated by D.V. Thompson. New York: Dover Publications.

[9] Miguel, C., Lopes, J.A., Clarke, M., Melo, M.J. 2012. 'Combining infrared spectroscopy with chemometrics analysis for the characterization of proteinaceous binders in medieval paints', Chemometrics and *Intelligent Laboratory Systems*, 119: 32-38.

Further reading

Written Sources

Blondheim, S. 1928. 'An old Portuguese work on manuscript illumination', *Jewish Quarterly Review*, 19: 97-135.

Other

Afonso, L.U. 2010. 'New developments in the study of O livro de como se fazem as cores das tintas', in L.U. Afonso (Ed.), *The Materials of the Image*, 3-27. *As Matérias da Imagem*. Lisboa: Campo da Comunicação.

D. Strolovitch. 2005. *Old Portuguese in Hebrew script: convention, contact, and convivência*, 116-184. PhD Dissertation, Cornell University.

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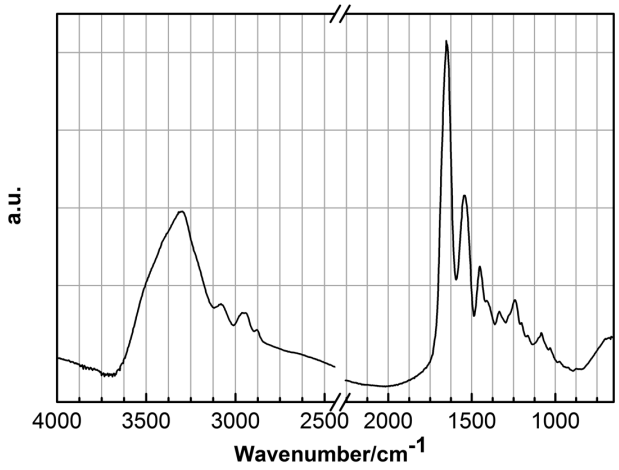
Appendix

Parchment glue characterisation: synthesised following 'The book on how to make colours', chapter 40.

Spectroscopic characterisation



Infrared spectrum acquired with a Nicolet Nexus spectrophotometer coupled to a Continuμm microscope with a MCT-A detector. Spectra were obtained in transmission mode, with a resolution of 4 cm^{-1} and 128 scans. The dry binder was previously compressed using a Thermo diamond anvil compression cell.