

ELUCIDATION OF THE DEGRADATION MECHANISMS IN ARCHAEOLOGICAL BIRCH BARK

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The availability and unique physical properties of wood and barks have made them the material of choice since ancient times for the production of everyday life and artistic artefacts. Objects constituted by wood or bark are preserved for long periods of time only under particular conditions, such as very dry conditions in arid or cold climates or wet environments.

In this field is our work, being its primary aim to assess the preservation and the state of degradation of archaeological findings made up of birch bark. In particular, we studied samples from a Neolithic bow case conserved in permafrost and samples of a Neolithic bark vessel conserved in a waterlogged environment.

Suberin, an extracellular lipid polymer, along with triterpenoid compounds are the main chemical components of birch bark. From a chemical point of view, suberin is a non-extractable and still unknown complex biopolyester formed by esterification of fatty alcohols, fatty acids and diacids, hydroxy fatty acids with glycerol, including also ferulic acid and eventually other phenolic components [1,2]. Suberin composition can vary among plants of different species, but some variability also occurs within plants of the some species (geographic origin, status of the trees, collecting method).

In the literature, several wet chemical method were used for the depolymerisation of suberin by cleavage of the ester bonds, in order to analyse its monomeric sub-units. The depolymerisation pre-treatment is an essential step for the chemical characterization of this material. The depolymerisation is based on chemical reaction achieving the cleavage of ester bonds: alkaline hydrolysis, trans-esterification or reductive cleavage have been used. The most common procedures in most published studies are the ester cleavage through alkaline methanolysis (NaOMe or CaO in MeOH) and alkaline hydrolysis using hydroalcoholic KOH [3-6].

Here we study the monomer composition of birch bark (reference material) and of four archaeological samples conserved in different environment conditions, such as permafrost and waterlogged sites, using two different hydrolysis procedures with KOH: saponification assisted by microwave and saponification in water bath. In addition, gas chromatography-mass spectrometry (GC/MS) was used to characterize the suberin and the terpenoid components. in addition, SEM observations were used to state the morphological aspect and thus, the condition of preservation of the birch bark objects.

The chromatographic profiles of reference birch bark revealed that the saponification in water bath is better than microwave because conserves the labile components of the suberin, such as epoxy groups (Fig.1). Samples collected from the archaeological objects show chromatographic profiles different from that obtained for the reference material: the chemical variations can be related to the aging processes taken place in the environmental conservation

conditions. In particular, the amount of free acids e increases in suberin, while the epoxy compounds decrease (Tab. 1). In addition, an increasing of oxidation degree can be observed only in the archaeological samples conserved in waterlogged sites.

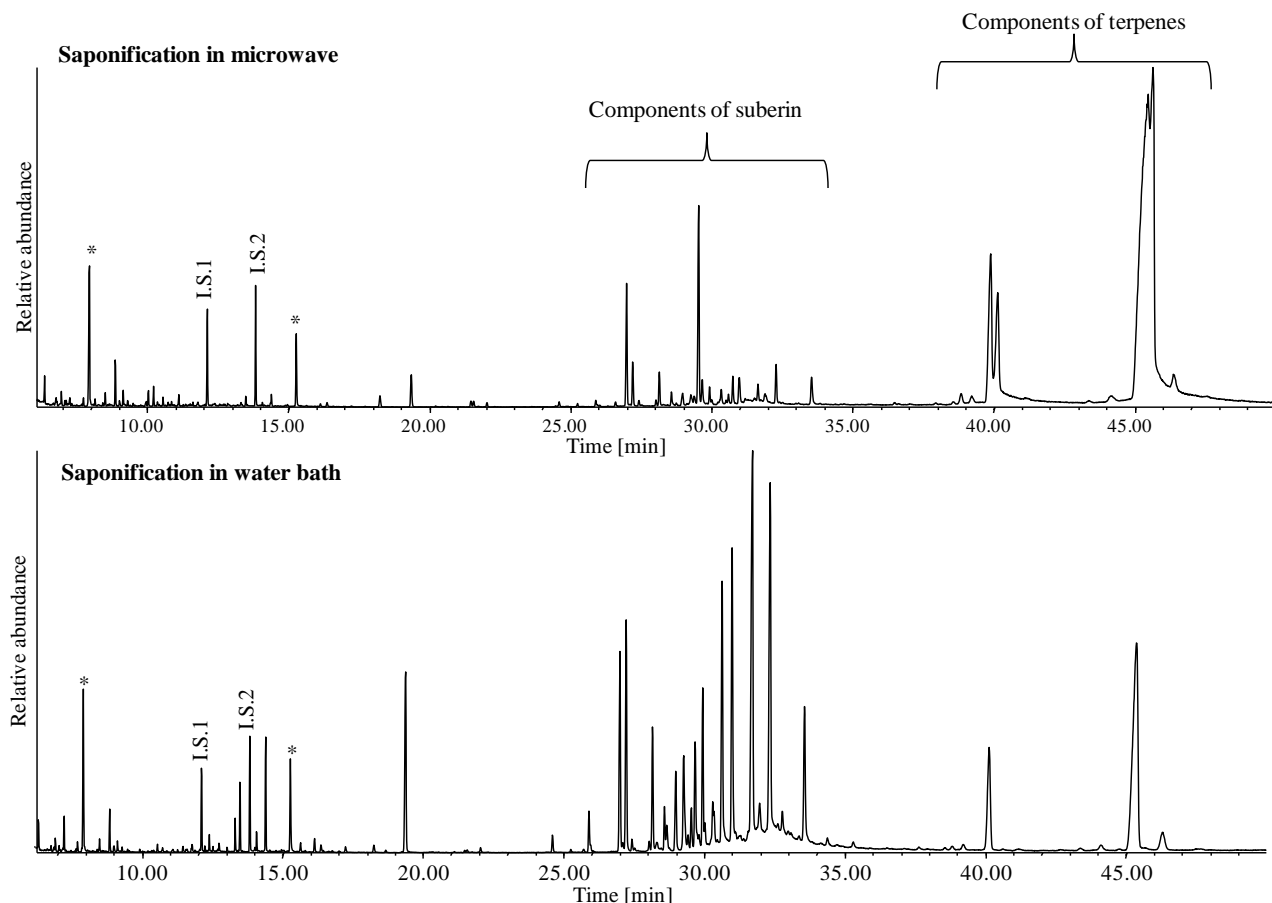


Fig. 1. Chromatograms of birch bark (reference material) after saponification in microwave (up) and water bath (down).

Tab. 1. Percentage amount of free organic compounds and suberin components in birch bark and archaeological samples conserved in permafrost and waterlogged sites.

	birch bark (reference material)	archaeological (permafrost)	archaeological (waterlogged)
% of free compounds	0	0.054	0.156
% of suberin compounds	1.27	0.65	0.21

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