

# Joint research activity

## From botanical source to analytical result

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### Scope

The overall aim of this research is to get a better understanding of the effects growing a botanical source, dyeing textile or pigment preparation, sample pre-treatment and ageing have on the interpretation of the analytical result. As the number of variables is huge, we would like to recognize the most crucial parameters which affect the overall colour and correlate these to the analytical result. We will focus on six well known sources, three related anthraquinone dyes (madder, wild madder, galium species) and three related flavonoids dyes (weld, dyer's broom, sawwort).

### The effect of climate, recipe, ageing and analysis

It is known that the composition of the colouring material in a dye source can be affected by the conditions of the environment, such as weather, soil etc. In addition, the recipe used to dye a textile or prepare an organic pigment can affect the colorant composition as well. Furthermore, the composition can be affected by ageing and the procedure used to extract the colorant from the sample. From each species, several plants from different origin will be collected. The plants will be extracted and the extracts will be analysed to determine the most significant differences. Next, for each species several recipes will be tested to determine the effect on the composition in the dye bath and on the substrate.



Preparation of the reference materials using weld, filtering of an organic pigment (left) and wool dyed according to two different recipes (right)

### Investigation of mild extraction techniques

If a substrate (textile, pigment) is present, the organic colorant is brought into solution if HPLC analysis is required. For this, several extraction techniques are known, all with their own advantages and limitations. Literature is sometimes contradictory with respect to the outcome of research to determine the optimum extraction test; this could be due to differences in sample procedure. Within CHARISMA, a selection of extraction tests and samples will be investigated in a round-robin test



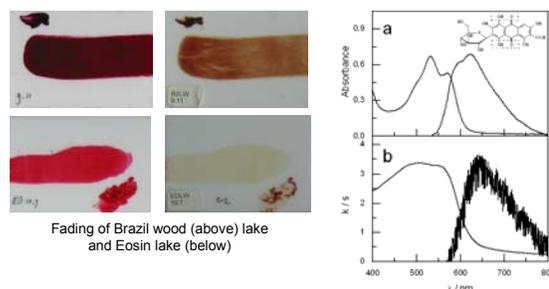
Dyes extracted from textile samples

### Preparation of rare standards

Reference materials of the most important organic colorants are widely available. However, in several species side products are found next to the main colouring component. The aim of this subtask is to isolate these unknown side products from the dye bath for further investigation with NMR, LC-MS, RAMAN, FTIR and HPLC-PDA. Identification of these materials can help understand the properties and behaviour of the original colorant.

### The photochemistry of metal-organic colorant complexes

Lake pigments were an essential constituent of the artist's palette; they gave depth and transparency to the richly glazed draperies and mixed or glazed over white, blue or yellow inorganic pigment gave particular hues. Lake pigments are very fugitive, depending on the substrate used. Within this task, research will be devoted to the influence of the complexation and nature of the substrate on the properties of the lake pigment.



Absorption and emission ( $\lambda_{exc} = 520$  nm) spectra of carmine lake in a) diluted dimethyl sulfoxide DMSO solution and b) on powder ( $\lambda_{exc} = 520$  nm). The chemical formula of carminic acid showing two chelation sites (dotted rectangles) is also reported

### Characterisation of synthetic dyes

Within this task, new analytical routes will be investigated. Based on the different dye classes available in the 19<sup>th</sup> century, we would like to investigate the possibility of non invasive identification directly on the object, non invasive analysis of samples taken from the object and finally invasive analysis of the samples. Techniques which will be considered are RAMAN, FTIR, UV-Fluorescence, UV-VIS reflectance spectroscopy, HPLC-PDA en LC-MS.



Reference materials, synthetic dyes  
Left, pure dyestuff, right dyed textiles