

Identification of natural dyes in some archaeological Iranian carpets by non-destructive MALDI TOF MS

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Abstract

The present study introduces a non-destructive method of analysis by MALDI TOF Mass spectrometry to identify the natural dyes in four Iranian archaeological carpets, date to the 17-18th century, attributed to Sarband and Tabriz cities. The study aims to unveil a method of analysis that may not have been used in dye analysis and to identify the samples taken from these carpets, which have reached a high rate of deterioration, and need a rapid intervention to be preserved. The study proved using natural indigo in blue, light blue, navy, and pale navy in the four carpets. The use of natural indigo (as a blue dye) has also been proved in oily, light oily, and greenish-blue samples in the four carpets along with weld and Persian berries dyes in the light oily color sample in Tabriz II. The madder and cochineal pigments were proven to be used in dyeing with the coppery red color in the first Sarband carpet. The madder and yellow dye were used for dyeing with coppery red color in the second Tabriz carpet. The madder dye has been proven to be used in dyeing with the coppery red and brick red in the third/fourth carpet. The results showed the use of weld dye in the beige color in the third/fourth carpet, while, no dye was detected in the beige color in the first and second carpet, as well as the pale yellow color in the second carpet. The examined Mass method proved a non-invasive, very fast, and high ability in identifying many dyes' compounds, without any dyes extraction or sample preparation. The method was unable to distinguish between compounds of the same molar mass, e.g. indigotin and indirubin compounds in indigo. So far, and according to the followed methodologies, the method was detected relatively few numbers of dyes' compounds, so, the type of dye isn't confirmed due to the presence of the same compound in more than one dye. Due to its many features; the study recommends more research about this method to unveil the reasons for the less detected compounds, and whether it can be overcome.

keywords:

Natural dyes, Iranian carpets, MALDI TOF MS, Investigation and Analysis, Non-destructive.