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ORGANIC COLOURANT ANALYSES OF THREE FIBRE SAMPLES FROM THE RGZM

Technique

The dye composition of the samples is analysed using liquid chromatography with photo diode array detection[1]. U.V.-visible absorbance spectra from the detected compounds are recorded and compared with reference spectra. The relative proportions of each dye compound, expressed as percentages, are calculated after peak area integration at the wavelengths chosen in function of the dye compounds found, *in casu* 255 and 288 nm wavelengths.

Discussion analyses

Violet wool in O.22195 (Kat.-Nr. 12)

The violet woollen thread from textile O.22195 consist of different shaded fibres, going from dark blue/black, to red and uncoloured ones (**fig. 1**).
Dye analysis confirmed this as the detected dye constituents refer to two biological dye sources. The anthraquinone dye compounds alizarin, purpurin, munjistin and anthragallol are characteristic for the use of the roots of a plant from the *Rubiaceae* family, a vegetal red dye source, while indigotin is an indigoid compound indicative for the use of either oriental indigo (*Indigofera* or *Polygonum* species) or European woad (*Isatis tinctoria* L.). **Table 1** gives the relative proportions of the identified dye compounds.

sample	dye composition	biological source(s)
O.22195 violet weft, wool	1 anthragallol, 3 munjistin, 16 alizarin, 7 indigotin, 73 purpurin (1)-255 nm 100 indigotin (1)-288 nm	roots from *Rubiaceae* family + woad / indigo
O.22285 brown weft, wool (S-twist)	40 ellagic acid, 19 alizarin, 5 indigotin, 36 purpurin (1)-255 nm 100 indigotin (1)-288 nm	roots from *Rubiaceae* family + woad / indigo + tannin
O.03261 violet weft, wool (Z-twist)	32 IND, 60 MBI, 8 MBIR (1)-288 nm 7 IND, 41 MBI, 52 DBI (2)-288 nm	Murex purple

Tab. 1 HPLC-DAD analysis. Detected dye composition of the sample after extraction in MeOH/HCl/H2O (1) or DMSO (2). – IND: indigotin; MBI: 6-monobromoindigotin; MBIR: 6-monobromoindirubin; DBI: 6, 6'-dibromoindigotin.

1 Vanden Berghe/Gleba/Mannering 2009.

Fig. 1 Microscopic image of the fibre composition of the violet thread (O.22195).

A high relative ratio is found between purpurin and alizarin (82/18) which is in agreement with earlier studies of Egyptian textiles that are purple dyed with a madder type and an indigoid source. It cannot be ascribed with certainty if this composition is related to the use of madder (*Rubia tinctorum* L.), hence implying that a deviating dyeing condition would be the cause of the different ratio between the principal dye compounds specific for purple colours, or that either another *Rubiaceae* plant species would have been applied[2].

Brown wool in O.22285 (Kat.-Nr. 187)

Fig. 2 Microscopic image of the fibre composition of the brown thread (O.22285).

Also the brown wool sample contains fibres from red and blackish colours (**fig. 2**). Both purpurin and alizarin are found, together with indigotin. This wool is composed of a mixture of red and dark blue fibres, dyed respectively with the roots of a plant from the *Rubiaceae* family and with woad/indigo. The relative ratio of purpurin/alizarin of 65/35 is characteristic for the use of madder (*Rubia tinctorum* L.). The important amount of ellagic acid suggests that tannin were added to the fibres to obtain a dark red, brown shade.

Violet wool in O.03261 (Kat.-Nr. 98)

Fig. 3 Microscopic image of the fibre composition of the violet thread (O.0361).

The violet Z-twisted wool thread from O.03261 is composed of homogeneously dyed dark violet fibres (**fig. 3**). The sample was first analysed after acidic extraction allowing identification of both mordant and indigoid dyes. This resulted in the detection of 6-monobromoindigotin (MBI) as the major compound, together with indigotin (IND) and a small amount of 6-monobromoindirubin (MBIR), revealing that this violet wool was clearly dyed with purple from molluscs. A second analysis of the sample after extraction in dimethylsulfoxide (DMSO) confirmed the true purple dyeing revealing the presence of in total 93 % of brominated indigotin compounds (6,6'-dibromoindigotin (DBI) and 6-monobromoindigotin) relative to 7 % indigotin.

2 Vanden Berghe 2011. – Wouters 2009.

The three main species for the purple dyeing in Mediterranean region are Hexaplex trunculus, Bolinus brandaris and Stramonita haemastoma. Species definition based on the relative ratios of brominated and not brominated compounds of the actual identified composition is still quite arbitrary, as partial debromination might have occurred during analysis or earlier during dyeing or preservation of the textile object.
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The use of royal purple for the coloured stripe of this fine linen fabric is a clear indication of the high value dedicated to this garment! Only few evidences exist of true purple dyed textiles in an Egyptian context. Other relevant detections of murex purple are in a very narrow purple *clavi* from a linen tunic fragment KMKG ACO.Tx.2477 from the Musées royaux d'Art et d'Histoire in Brussels, radiocarbon dated 240-400 AD (95.4 % probability)[3] as well as in two other pieces with small purple decorations KTN 1475 and KTN 620/DM139 belonging to the Katoen Natie Collection, radiocarbon dated respectively 420-550 AD and 660-780 AD (95.4 % probability)[4]. Three other Murex purple dyed textiles were found in the eastern desert sites of Egypt dated to either Roman or Coptic Egyptian period[5].

3 De Moor u. a. 2010.
4 Dye and radiocarbon analysis done at KIK-IRPA.
5 Wouters 2009. – Wouters u. a. 2008.