Identification of Dye Compounds in Chinese Artifacts by GC MS

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BACKGROUND

- UNI Museum homes wide variety of textile artworks.
- Many of them have historical significance. Two of them are UNI Museum 2005.2.24 (Tapestry) and UNI1986.14.1985.1.124 (Hanging).
- Rectangular Textile
  - Dimension: 158 cm × 74 cm
- Dark blue silk embroidery of an old bearded man believed to be Chinese god, Shou-Hsing
- Contrast floral designed 1” border
- "Made in China" stamp on the plain cotton fabric back

OBJECTIVES

- Identify the dye compounds in textiles.
- Determine if the dyes used in textiles are natural or synthetic.
- Date the textiles based on dye compounds.

SAMPLE PREPARATION

- Two different methods: HCl method and EDTA method were used for extraction of sample for GC-MS analysis.
- For HCl method, 0.2 mg sample was placed in 400 μL of 37% HCl+ methanol+ water in the ratio of 2:1:1 in microcentrifuge tube. The solution was heated at 100 °C for 10 minutes.
- For EDTA method, 0.2 mg sample was placed in microcentrifuge tube with 400 μL of 0.001 M aqueous H₂EDTA + acetonitrile + methanol in the ratio of 2:10:88. The solution was then heated at 60 °C for 30 minutes.

INSTRUMENTATION

- GC-MS is the combination of two different analytical techniques: Gas Chromatography(GC) and Mass Spectroscopy(MS)
- GC separates the components in gas and MS identifies the compound.
- The samples are vaporized in injector port and carried by carrier gas through the column.
- The sample moves through column placed inside the temperature-controlled oven with stationary phase coated on the inner wall.
- The sample gets separated based on their volatility and size.
- They pass through the transfer line exiting GC to the MS.
- The samples get ionized and are detected based on their charge to mass ratio.
- The data is then analyzed using the library of samples to identify the compound.

RESULTS

- All the HCl extracted samples did not result in useful identifying data (Figure 12).

CONCLUSIONS

- Dye compounds are identified in the sample of both textile artifacts: Tapestry and Hanging analyzed.
- All the dyes identified in both textiles are synthetic dyes.
- As the development of synthetic dye first began in 1856 and were imported in China in 1871, it can be concluded that the artifacts were made in late 19th century.²

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REFERENCES