E125 The Ability of Cotton, Polyester, and Wool to Retain Diatomaceous Evidence Following Submersion to Study the Postmortem Submersion Interval (PMSI)

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Learning Overview: After attending this presentation, attendees will understand how common fabrics retain diatomaceous evidence and how this information can be useful in an investigation involving victim submersion in a body of water.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by advancing the knowledge of how diatomaceous materials are retained by different fabrics, assisting in the determination of crime scene location, transfer events, and, potentially, the PMSI.

Diatoms are unicellular, photosynthetic algae that are classified as *Chrysophyta* and Class *Bacillariophyceae*.[1,2,3] The microscopic nature of diatoms, which range in size from less than 5 to more than 500 microns, results in accumulations of 25-50 million cells in just one cubic inch of diatomite.[1] The relative abundance and small size of diatoms makes them ideal for forensic geoscience applications.[4] This area of forensics deals with comparison of environmental samples to establish or refute a common source.[4] The use of diatomaceous evidence in comparative trace analysis and relating it to postmortem events is currently an understudied area.

Historically, the forensic application of diatomaceous evidence has been limited to the diagnosis of drowning deaths.[2] The diatom test has been used for this purpose since 1942 and is based on the premise that diatoms do not occur naturally in the human body.[3] Diatoms enter the circulatory system and deposit themselves in organs, such as bone marrow and the brain.[2] Verma suggests that diatom analysis can be enhanced through analyses of submerged clothing or footwear in contact with the suspected drowning medium.[3]

The necessity of research into the forensic geoscience application of diatoms is further enhanced by the potential for diatoms to be utilized for the determination of PMSI.[4] The PMSI is the time interval between submersion and time of discovery of an item or victim.[6] Diatoms are initial colonizers of aquatic systems and they are dominant during algal succession.[6] This makes diatoms ideal organisms for PMSI determination. Zimmerman & Wallace were the first to develop a semi-quantitative approach to PMSI determination based on diatom diversity as a function of time.[6]

To date, only two studies have been conducted regarding the extraction of diatoms from clothing, and both studies strictly used cotton.[4,5] Since clothing material is frequently recovered from crime scenes, it is important to understand how a variety of fabrics will retain trace materials. In forensic science, it is equally important to use optimized extraction techniques that provide a representative sample. Scott et al. developed a novel hydrogen peroxide extraction technique that yielded the highest number of diatoms and the most representative samples in comparison to the rinsing with water and rinsing with ethanol techniques.[4] Since the other two methods were not as representative of the reference samples, these should not be used in a forensic application where species composition is analyzed to determine source. To build on the current knowledge of how diatomaceous evidence is retained by fabrics, the following research question was proposed: Will the type of fabric affect the number of diatoms that are retained?

A 30% hydrogen peroxide extraction method was performed for three common fabric types (cotton, polyester, and wool) to retrieve embedded diatomaceous material. Resulting yields were examined using light microscopy and scanning electron microscopy. Slides were mounted with a mounting media suitable for the refractive index of diatoms. The research aimed to optimize the method for diatom extraction and compared the ability to yield diatomaceous evidence from cotton, polyester, and wool. The results for the optimized method were analyzed by one-way Analysis of Variance (ANOVA). An analysis of variance showed that the effect of type of fabric on the number of diatoms retained was significant, $F(2.27)=32.067$, $p=0.000$. A Tukey post hoc test was conducted to determine which fabrics were different in retention. A relationship was found between cotton and polyester ($p=0.206$). All other fabrics were significantly different ($p<0.05$). This research furthers the knowledge of the forensic community by providing information about how different fabrics retain diatomaceous evidence.

Reference(s):

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Postmortem Submersion Interval, Diatoms, Pathology