B67 Trinitrotoluene (TNT) Recovery Via Microbial-Vac System (M-Vac) Collection

Jacqueline Ruchti, BS, IUPUI, Indianapolis, IN 46202; John V. Goodpaster, PhD, FIS Program, Indianapolis, IN 46202*

Learning Overview: After attending this presentation, attendees will better understand the recoverability of TNT from post-blast debris after collection via the Microbial-Vac System (M-Vac).

Impact on the Forensic Science Community: This presentation will impact the forensic science community by introducing novel partition coefficients for TNT as well as a potential collection technique for simultaneously collecting DNA and explosive residue from post-blast debris.

Analyzing the overall construction of an explosive device, as well as the explosive used, can yield information about the bombmaker or terrorist organization and provide links to other devices. Simultaneous analysis of post-blast debris for DNA and explosive compounds could improve explosives investigations. Hence, DNA and explosive residues would need to be separated via an extraction method. Methods of liquid-liquid extraction, charcoal strip extraction, and filtration were determined for extracting 2,4,6 – trinitrotoluene (TNT) prior to traditional DNA extraction methods.

The partitioning of TNT, a common military explosive, was studied for the following four aqueous/organic solutions: water/chloroform, Lysis Buffer/chloroform, Lysis Buffer with proteinase K (incubated)/chloroform, and Butterfield's Buffer/chloroform. A liquid injection method was developed for the chloroform layer. An immersion solid-phase microextraction method was developed for the aqueous layer. Since the Log P value for TNT in an octanol/water solution is 1.6, TNT was expected to partition by approximately 40:1 between octanol and water. However, the partitioning of TNT between chloroform and Water was inconclusive. TNT partitioned by approximately 3:5 between chloroform and Lysis Buffer, 1:2 between chloroform and Lysis Buffer with proteinase K (incubated), and 35:2 between chloroform and Butterfield's Buffer.

Due to the ability of the Microbial-Vac System to collect DNA from rough and porous surfaces, the device also was tested for its effectiveness in collecting TNT. Evidence collected via the M-Vac device was analyzed by the following GC/MS application methods after extraction. Samples prepared via the chloroform partition method or charcoal strip extraction method were run via liquid injection while samples prepared using filtration method were run via liquid immersion SPME. Following the application of a 50 ppm chloroform solution of TNT to pieces of a white t-shirt, TNT was successfully detected via the chloroform partition method. To simulate samples from an explosives investigation, a backpack containing a pipe bomb filled with TNT was detonated in a secured field. However, TNT was not successfully detected in any post-blast backpack debris samples prepared via the three extraction methods. Upon performing a direct liquid extraction with other post-blast backpack debris samples, it was determined that TNT was not sufficiently present on the post-blast backpack debris samples tested. Hence, the M-Vac's efficiency for collecting TNT from post-blast debris is inconclusive.

Reference(s):

1. Beveridge, A. *Forensic Investigation of Explosions*. 2nd ed., CRC Press, 2012.
2. Ash, J. Design and implementation of Gas Chromatography/Mass Spectrometry (GC/MS) methodologies for the analysis of thermally labile drugs and explosives. Diss. Purdue University, 2016.

TNT, Microbial-Vac System (M-Vac), GC/MS