C7 Detection of Drugs on Fingermark Residue Using Nanoparticle-Based Fingerprint Powders Using SALDI TOF-MS/MS Technique

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After attending this presentation, attendees will have an understanding of the dual nature of fingerprint powders to develop and detect drugs on fingermark residue using Surface Assisted Laser Desorption Ionisation Time-of-Flight Mass Spectrometry (SALDI TOF-MS) technique.

This presentation will impact the forensic science community by providing results of trials and experiment conducted using nanoparticle-based ARRO MS latent fingerprint development powder. The presentation will provide experimental evidence using the powders in enhancing the definition of the developed fingerprint and to directly analyze the drugs on the lifted fingerprints.

The presentation will provide experimental evidence of the work performed to visually identify fingerprints using nanoparticle-based fingerprint powder. The developed print can then be lifted using lifting tape and can then be directly analyzed to identify the chemical constituents present within the fingerprints which might include any contact residue of the drug handled and/or metabolites of the drugs excreted through the pores of the skin. A range of drugs including therapeutic (paracetamol, aspirin, and lisinopril) and illicit (cocaine, methadone, and amphetamine) drugs were identified on fingermark residues (with or without cyanoacrylate fuming) after developing with nanoparticle-based latent fingerprint powders (ARRO SupraNano MS black magnetic powder) and analyzing using SALDI TOF-MS technique. Peaks were identified for all the drugs under study for the lifted fingerprints dusted with MS black magnetic powder and with Dihydroxy Benzoic Acid (DHB), a commonly used maldi matrix agent. Results were compared for lifted prints with or without cyanoacrylate fuming prior to dusting. For fingerprints dusted with MS black magnetic powder, in addition to the identification of the drugs, the developed fingerprints were highly defined, revealing more details of the fingerprints, due to the smaller diameter and the sphericity of the nanoparticles.

Method: Fingerprints spiked with therapeutic (paracetamol, aspirin, and lisinopril) and illicit drugs (cocaine, amphetamine, and methadone) were deposited on a clean glass slide, followed by dusting with MS black magnetic powder. The prints were then lifted using a standard fingerprint lifting tape and were stuck to a maldi target plate with the adhesive side facing up. Analysis was performed using Shimadzu Axima Performance Maldi TOF-MS after calibration using small molecule calibration mixture for the masses ranging between 132 to 607 using positive ionisation mode. Reference spectra for the drugs under study were obtained by spotting 1µl of the drug standard (10µg/ml) along with 1µl of 10mg/ml of DHB and analyzing it in positive mode. For the lifted fingerprint, laser shots were randomly fired across the fingerprint area and the average profile of the spectrum was collected using approximately 400 shots for each fingerprint region. Similar procedure was conducted for the spiked fingerprint without any dusting agent and with DHB dusting.

Results and Discussion: The nanoparticle-based SupraNano MS black latent fingerprint powder gave superior definition, exhibiting 3rd level ridge detail with high contrast against the background. The smaller diameter and the sphericity of the nanoparticles is the prime reason for the enhanced performance of the latent fingerprint powder.

SALDI analysis of the lifted fingerprints dusted with DHB and MS black magnetic powder gave M+1 peaks for all the drugs studied. However, for fingerprints dusted with MS black magnetic powder, sodium and potassium adducts of the drugs were also identified along with the M+1 peak for most of the drugs. Nanogram levels of the drugs were able to be identified on the lifted fingerprints dusted with MS black powder. The carbon black-doped silica nanoparticles used as the active ingredient in the latent fingerprint powder aids in the ionisation process, thereby enhancing the signal intensity even at trace level concentration.

With the results obtained, it can be concluded that the MS black magnetic powder can be used for the dual purpose of developing the fingerprint (with or without cyanoacrylate fuming) for superior definition and for directly detecting the chemical constituents present within the fingerprint using SALDI TOF-MS.

Nanoparticle, Fingerprint Powder, Drug Analysis

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