March 5, 2021

Analyzing Black Tar Heroin on FTIR

Background

Heroin (diacetylmorphine) comes in two main varieties: powder heroin and black tar heroin.[1] Depending on the local drug market, one of these varieties is historically more prominent in a given setting because they typically originate in different parts of the world.

Powder heroin can be further divided into two distinct types: HCl or base. Heroin hydrochloride (HCl) is typically white, grey, or beige, and is highly water-soluble due to its acidic properties. Heroin freebase, or base, is stereotypically darker brown and has low water-solubility, needing acidification (e.g., dissolved with the addition of Vitamin C). Heroin base is more easily vaporized, but heroin HCl can be prepared for smoking with the addition of caffeine.[2,3]

Black tar heroin originates in Mexico, is dark brown to black, and has a pasty to solid, sticky texture.[1,4] Black tar heroin is generally of lower purity, containing many contaminants since it has not undergone a significant purification process.

In British Columbia, heroin HCl is far more common than both heroin base and black tar heroin; however, it remains important to know about analyzing black tar heroin on the rare occasion someone presents it for drug checking.

FTIR Analysis

The distinction between heroin HCl and base is clear when conducting FTIR analysis (Figure 1). As such, when logging drug checking results, it is important to specify if the heroin present is HCl or base.

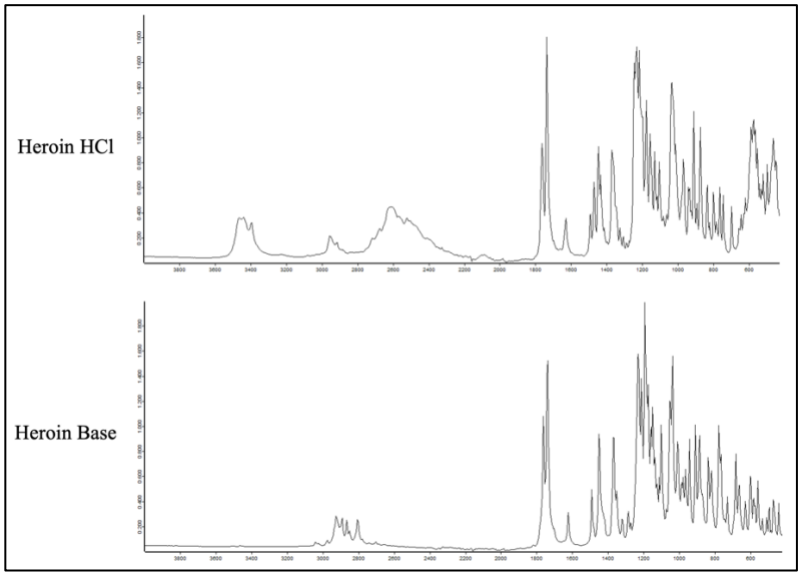

Figure 1. IR spectra of heroin hydrochloride (HCl) and heroin freebase.

Black tar heroin, due to its crude production and lack of substantial purification, has many contaminants (e.g., morphine, codeine, 6-monoacetly morphine, 6-monoacetyl codeine).[3] Other than these alkaloids, it likely contains leftover plant carbohydrates present in opium latex. Due to the texture and appearance of black tar heroin, it has assumed that it is often unadulterated and is a good way to avoid inadvertent fentanyl exposure in the absence of drug checking technologies.[5] Drug checking results from settings where black tar heroin is common have already detected the emergence of fentanyl-adulterated black tar heroin, however.[6]

Further, due to black tar heroin's sticky texture, it can leave a gummy residue on the FTIR spectrometer anvil. Attempt to spread the heroin onto the clean ATR sensor and avoid using the anvil. Using a piece of tin foil between the sample and the anvil can also help keep the anvil clean. If no tin foil is available and the anvil must be used for sufficient signal, like any other sample, be sure to clean the anvil thoroughly after measuring the sample.

Figure 2 shows the significant differences between the black tar heroin spectrum and the heroin HCl spectrum. Black tar heroin is likely hygroscopic, and holds onto water (note the water peak near 3500 cm^{-1}). Black tar heroin spectra are typically less-defined through the fingerprint region, likely due to the many contaminants present in low amounts. Due to the absorption peaks being wider (Figure 3), subtraction artefacts are common, leading to difficulty detecting secondary components.

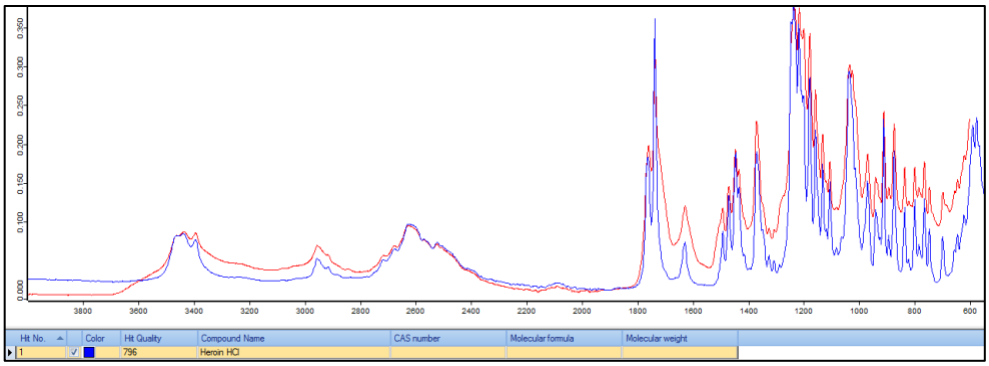

Figure 2. Overlapping spectra of a black tar heroin sample (red) and the reference for heroin HCl (blue).

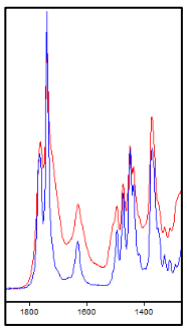

Figure 3. Zoom-in of overlapping spectra of a black tar heroin sample (red) and the reference for heroin HCl (blue). Note the widening of the bases of the absorption peaks in the black tar sample.

Black tar heroin is not always unadulterated. In Figure 4, black tar heroin sample shows a clear presence of a second component, and a subtraction of heroin HCl indicates a match for caffeine. Subtraction artefacts cause a significant over-subtraction of heroin signal, resulting in negative signal (below the baseline). Other adulterants or diluents present in black tar heroin may include lactose or quinine.[7]

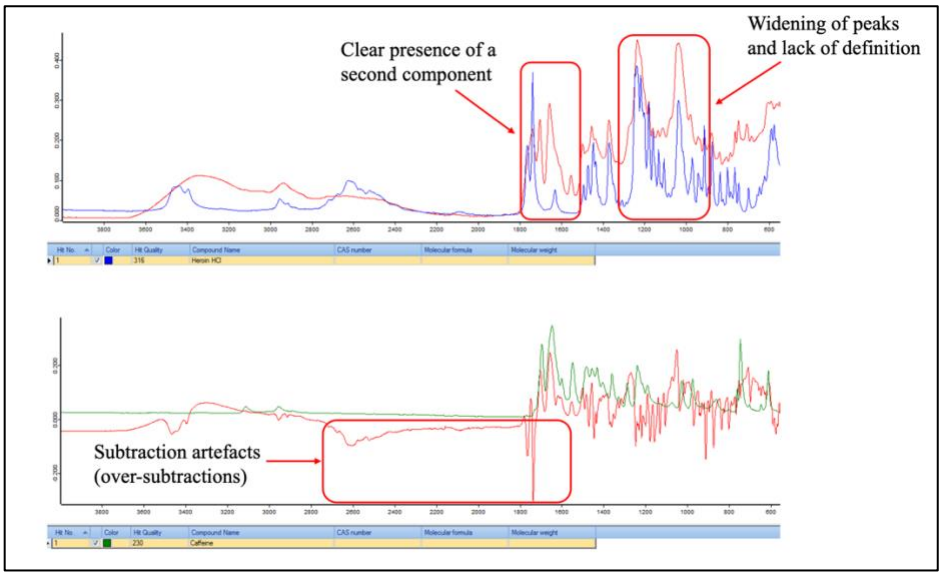

Figure 4. A sample of black tar heroin adulterated with caffeine. The original spectrum is on top, the subtraction indicating the presence of caffeine is below.

Fentanyl adulteration of black tar heroin is very unlikely to be detectable by FTIR. For that reason, fentanyl test strips should always be used when drug checking black tar heroin (all heroin samples, for that matter). As black tar heroin can be slow or difficult to dissolve in cold water,[1,4] use a 2 mL tube akin to the benzodiazepine test strip procedure.[8] This replicates the "cold shake" method to dissolve heroin in a syringe, and therefore will ensure if fentanyl is present, it dissolves to be detectable by a test strip.

Summary

Black tar heroin poses issues with FTIR analysis for drug checking due to its crude preparation, containing many contaminants leftover from its synthesis. Because of this, it may not match with FTIR library references as well as powder heroin, causing subtraction artefacts and difficulty identifying secondary components, including fentanyl. Further collection of black tar heroin samples may allow for improved method development for analyzing these particular samples, but confirmatory testing is required. For these reasons, fentanyl test strips should always be used on black tar heroin samples using a "cold shake" method to ensure the dissolution of heroin and any adulterants present.

References

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