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A Comparison of Portable Infrared Spectrometers and the Narcotic Identification Kit (NIK®) Field Test for the On-Scene Analysis of Cocaine HCl

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Abstract

The majority of inmates across the country are incarcerated for drug related offenses. It is important that the technology used to test for controlled substances is accurate and reliable. For on-scene presumptive testing, the NIK® Test G (Modified Scott Reagent) is most often utilized to test for the presence of a controlled substance. The NIK® Test G uses colorimetric reactions, which relies on a specific moiety of the drug molecule to react with the provided reagents to produce characteristic color changes. Infrared spectroscopy measures the absorption of IR radiation, specifically the vibrations of the bonds between atoms, to determine the structure of a molecule. This research compares the use of portable IR technology with NIK® Test G to determine which method is better suited for the on-scene analysis of illicit drugs, specifically cocaine HCl.

This research assessed important performance characteristics for each method, including a short and long-term cost analysis, whether the method is destructive or nondestructive, the ease of use, knowledge and skill required of the operator, speed of analysis, limit of detection, susceptibility to false positives and false negatives, and the effect of common diluents on the ability to identify cocaine.

Materials and Methods



Figure 1 : The HazMatID Elite Portable Infrared Spectrometer (left) and the diamond ATR sampling platform. (pictures courtesy of C. M. Dupper)

An analytical balance was used to measure the concentrations of two- and three-component mixtures with common diluents of cocaine. Those included chemical diluents (e.g., lidocaine, mannitol, and caffeine) as well as common household diluents (e.g., artificial sweetener and baby formula). Duplicates of each mixture were made. Each sample was tested with both the HazMatID Elite and the NIK® Test G, and replicates were obtained after initial data collection.

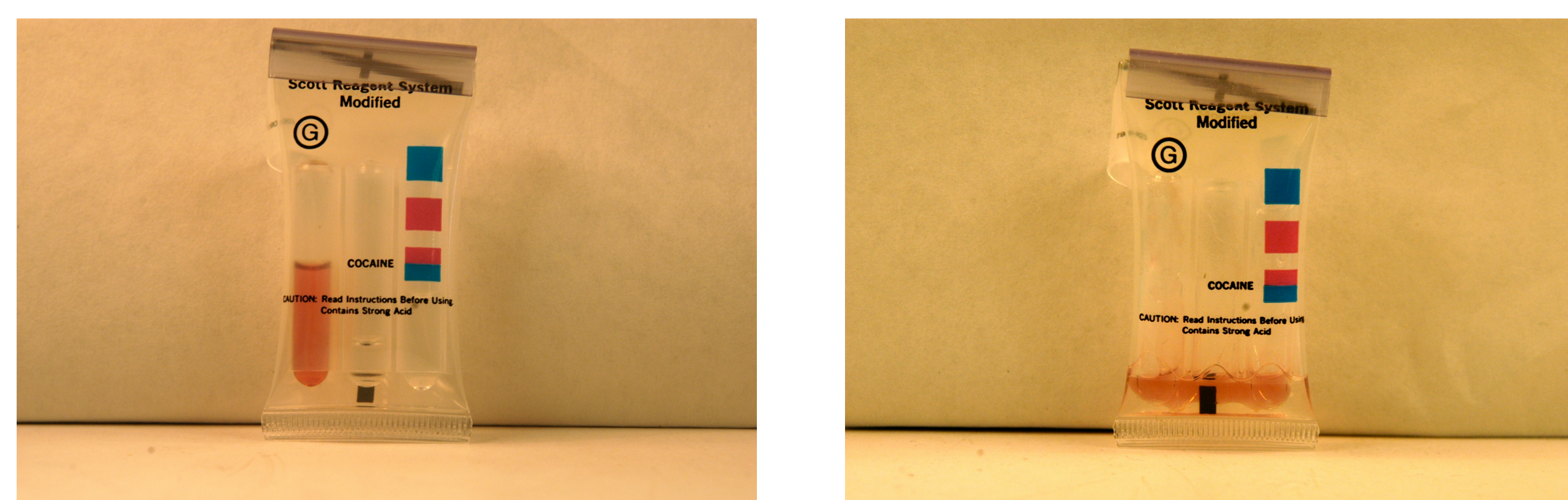


Figure 2: NIK® Test G untested (left) and negative result for Cocaine HCl (right)

Results

The NIK® Test G reached a consistent limit of detection at 5%. Samples containing 5% cocaine HCl or lower were not detected. A positive identification is indicated by a pink top layer and blue bottom layer; this bottom layer can vary in shade. A negative result is indicated by a pink top layer and a clear bottom layer, as seen in Figure 2.

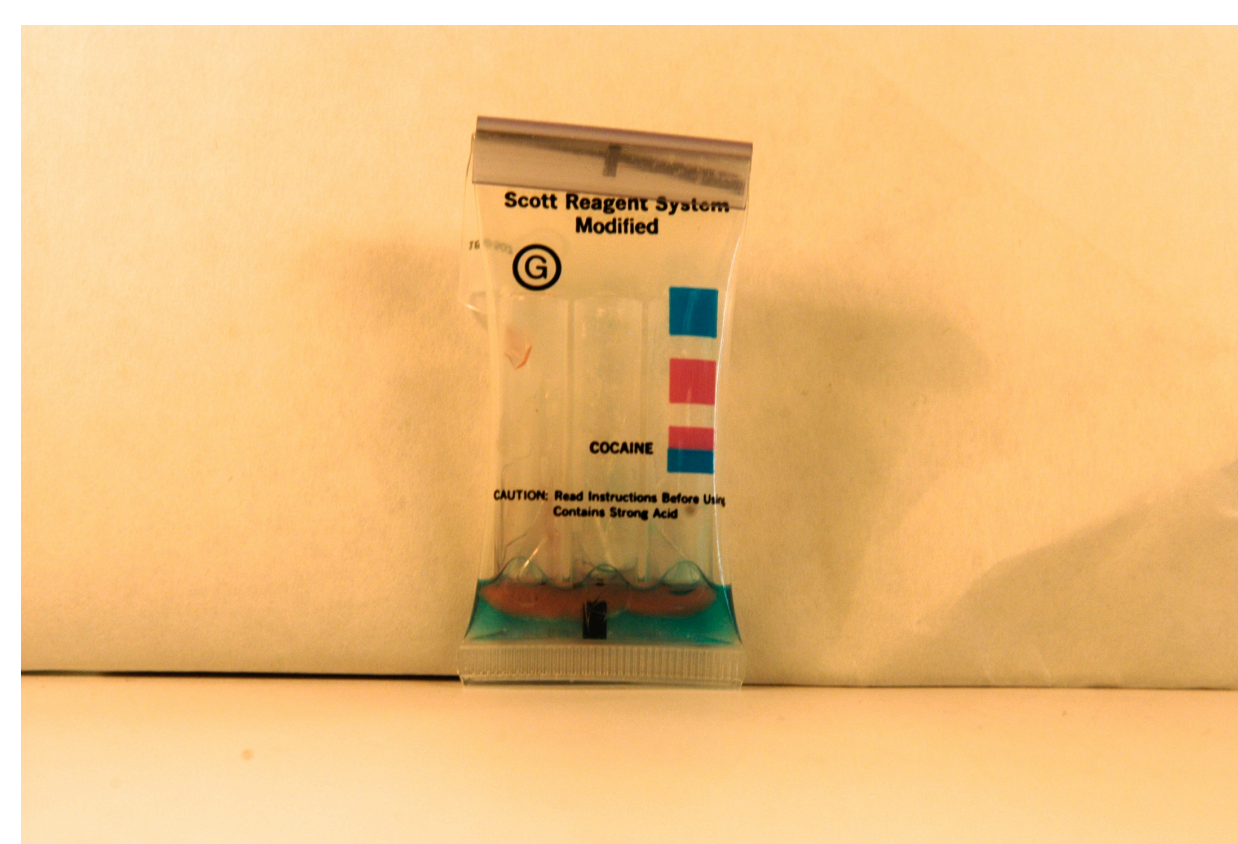


Figure 3: A strong positive result for cocaine HCl from a mixture that was 50% cocaine and 50% Mannitol.



Figure 4: A weaker positive result for cocaine HCl from a mixture that was 10% cocaine and 90% Mannitol.

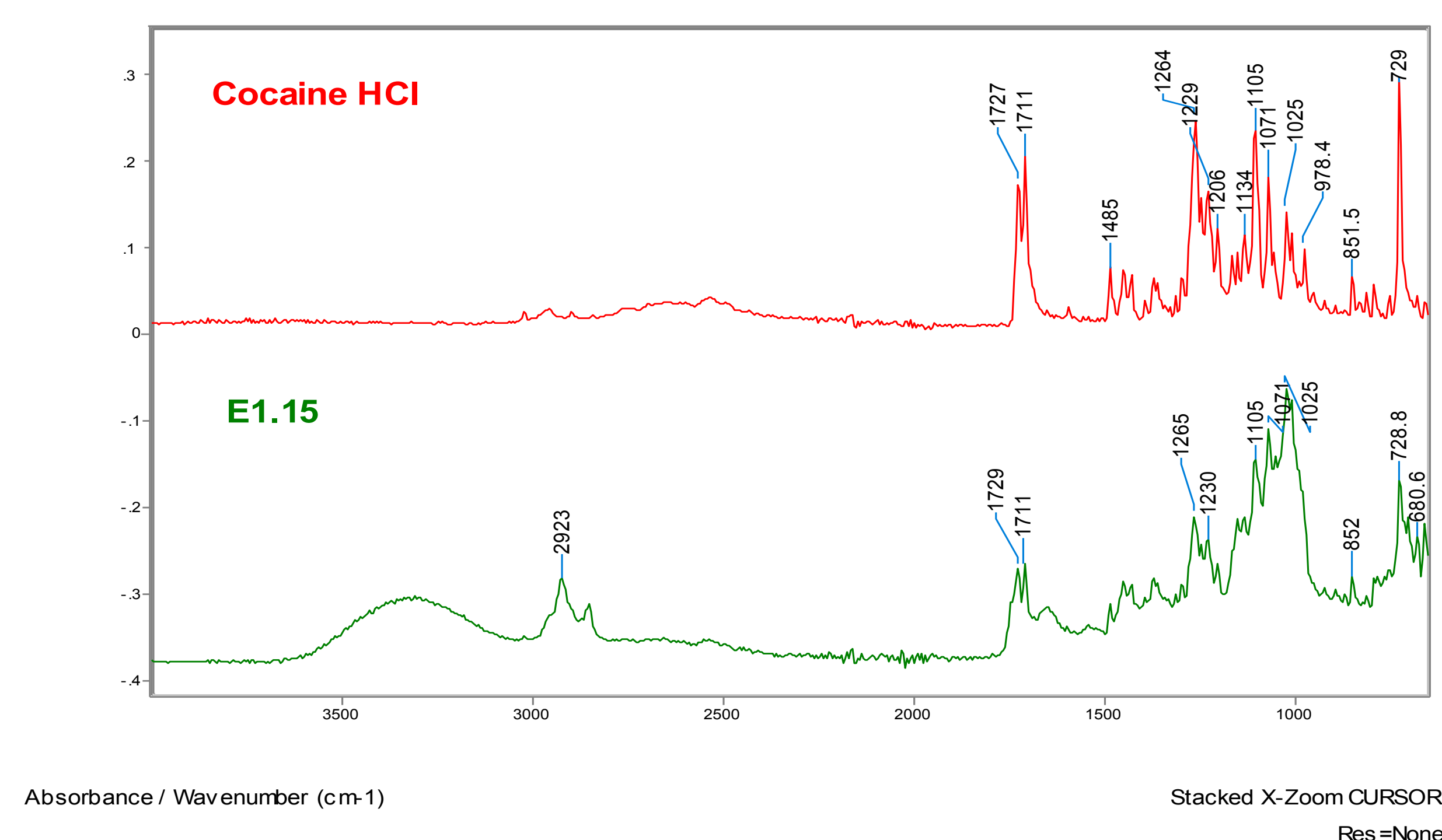


Figure 5: A positive identification of Cocaine HCl from a mixture that was 15% cocaine and 85% Enfagrow (baby formula). Spectra were uploaded to the GRAMS AI Spectroscopy Software for analysis.

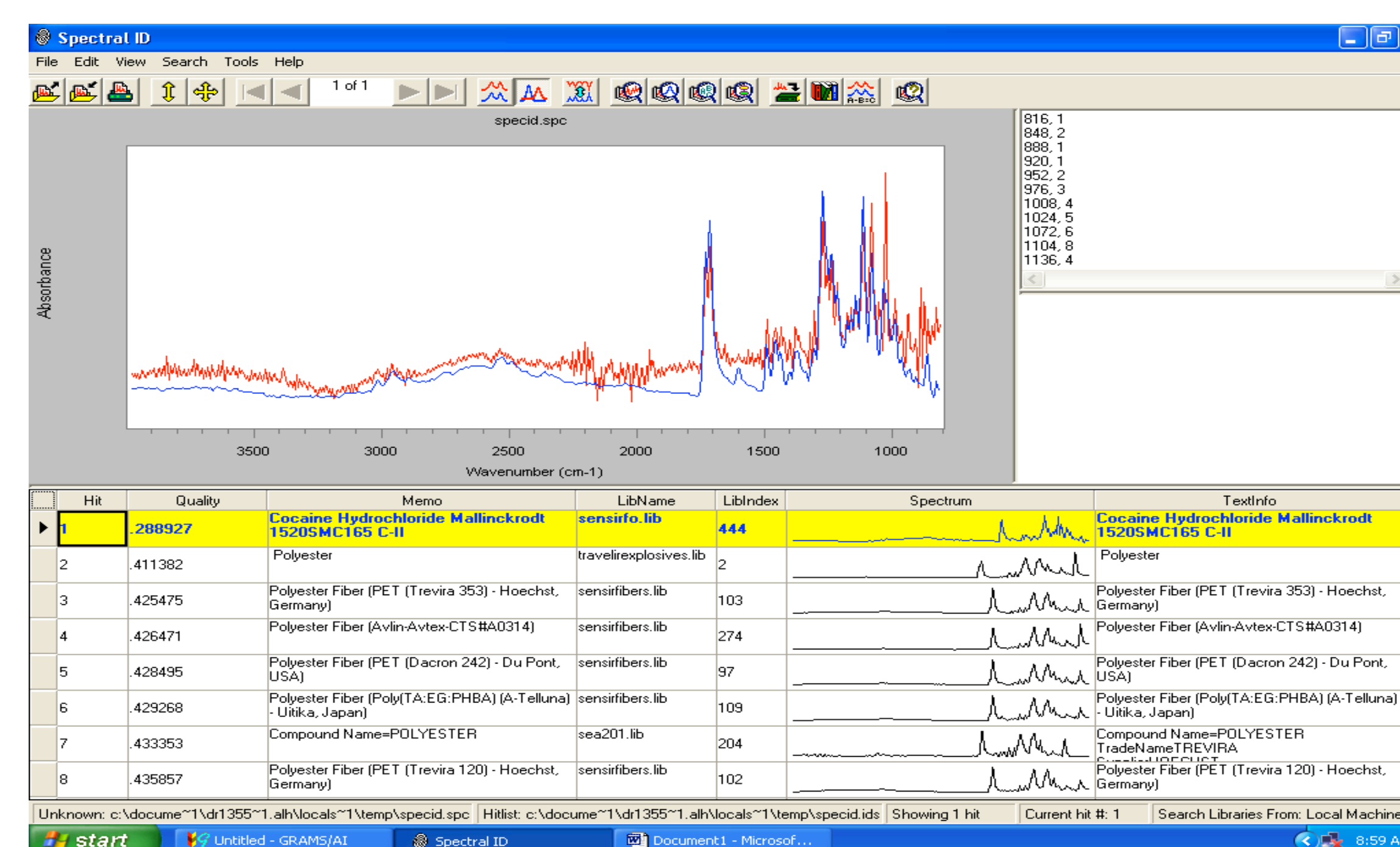


Figure 6: A positive result for Cocaine HCl after the spectral subtraction function on Spectral ID from the GRAMS AI software was used.

Conclusions

This research concluded that although portable infrared spectrometers require a large initial financial investment, their high performance characteristics (e.g., ease of use, rapid analysis, non-destructive, acceptable limit of detection, minimal false positives and negatives) makes them a superior tool than the NIK® Test G for the on-scene presumptive analysis of Cocaine HCl.

Specific performance characteristics included:

- The limit of detection for the HazmatID Elite was 15% and for the NIK® Test G was 5%.
- Lidocaine was identified to be a false positive for Cocaine HCl with the NIK® Test G, but not for the HazmatID Elite
- It was noted that the portable IR had difficulty identifying Cocaine HCl at 25% or lower, but manual spectral analysis still confirmed the presence of Cocaine HCl.

Future Work

The potential false positives and negatives for each technique will be explored further in my Honors Thesis. The performance characteristics for portable Raman Spectroscopy will also be analyzed and compared to those of the NIK® Test G and the portable IR Spectrometer. This research could be expanded to include other controlled substances to help evaluate the real-world application of the techniques.

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Acknowledgements

The authors would like to thank the University of New Haven Summer Undergraduate Research Fellowship (SURF) program for providing the funding and opportunity to conduct this research. We are grateful to the University of New Haven Forensic Science Department for providing supplemental materials. Also, we greatly appreciate all of the faculty of UNH's Forensic Science Department, and would especially like to thank Sandra Hartman-Neumann, the Forensic Science laboratory manager, for all of her help.