Application Note AN-RS-032

Raman and SERS identification of a combination prescribed opioid

Two chemical analyses from one tablet

Handheld Raman spectrometers are valued for their ability to provide onsite material identification in seconds. A simple point-and-shoot analysis of bulk materials with the handheld MIRA DS results in chemical identification accompanied by both statistical support and relevant color-coded warnings. In the case of combination pharmaceuticals, a single tablet contains more than one active ingredient in different proportions. MIRA DS is uniquely capable of identifying multiple compounds in such tablets by using Raman to identify the major component and SERS (surface-enhanced Raman spectroscopy) for the minor component.

This application describes quick, dual analysis of a prescription medication containing acetaminophen and hydrocodone. The application is easily extrapolated to the study of street drugs. With MIRA DS, forensic analysis of tablets reaches a whole new level of accuracy.

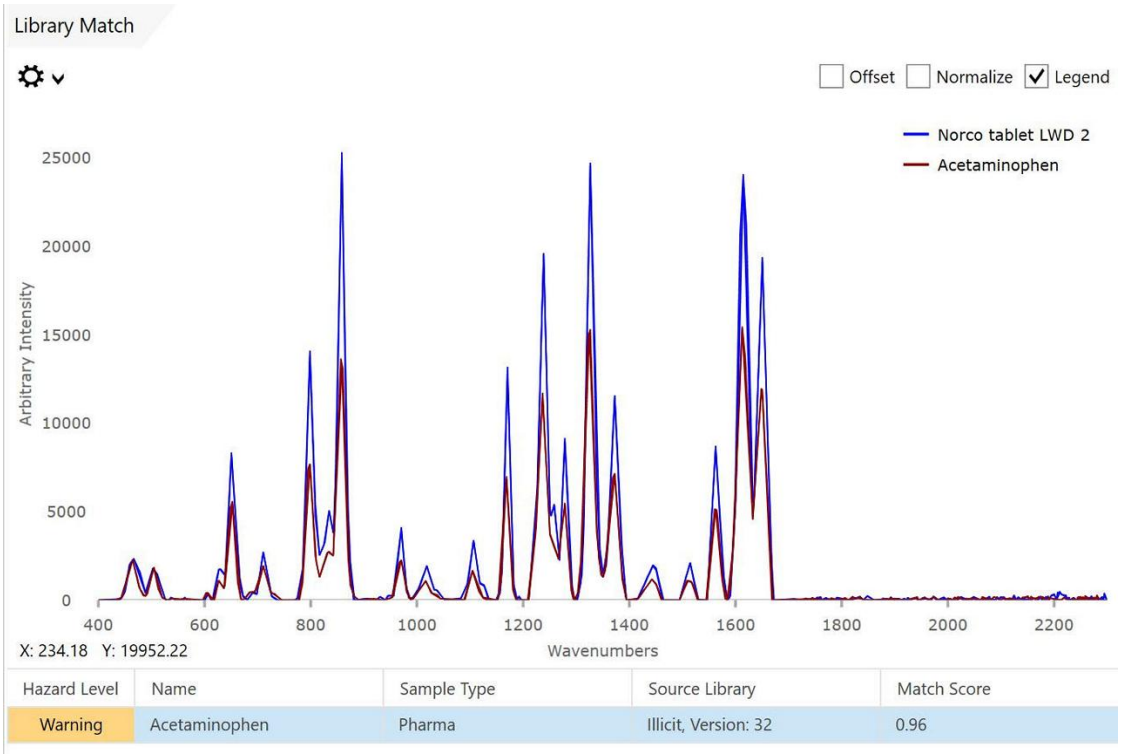
INTRODUCTION

Norco® is a combination pharmaceutical containing 5 mg of hydrocodone, an opioid pain medication, and 325 mg of acetaminophen, a less potent analgesic that enhances the effects of hydrocodone. As with all opioids, Norco® has the potential for deadly side effects and may be habit-forming. Such medications require restricted access for children and care to avoid potential recreational use. Raman spectroscopy may be used to identify tablets for the purpose of controlling recreational use of prescription drugs. A Raman scan of Norco® would simply report the bulk material: acetaminophen. Identification of hydrocodone component requires trace analysis with SERS. MIRA DS offers both Raman and SERS analyses with its signature compact size, ease-of-use, speed, and sampling flexibility.

SAMPLING WITH RAMAN

The beauty of sampling with MIRA DS is its simplicity. A Long Working Distance (LWD) Smart Tip (8 mm focal length) was used to penetrate beyond the tablet coating. Once the LWD was attached to MIRA DS, it automatically activated Smart Acquire routines that prompted the instrument to optimize acquisition parameters, take a sample, and match to internal libraries—all in less than a minute.

Figure 1 contains Library Match information as it is seen in Mira Cal DS. The red Norco® sample spectrum matches very nicely to the library spectrum of acetaminophen, with a Hit Quality Index (HQI, a measure of spectral correlation) of 0.96.



Hazard Level	Name	Sample Type	Source Library	Match Score
Warning	Acetaminophen	Pharma	Illicit, Version: 32	0.96

Figure 1. Mira Cal DS spectrum of Norco® tablet with acetaminophen library match supported by high HQI = 0.96.

SAMPLING WITH SERS

Crushed Norco® was dissolved in methanol to prepare a 1 mg/mL solution. Then, 100 µL each of the Norco® solution and 50 mmol/L NaCl solution were added to a glass vial with 800 µL of proprietary SERS gold colloid solution (available from Metrohm Raman). The vial was capped, shaken, then inserted into the Vial Holder Smart Tip on MIRA DS. Selection of the SERS OP, laser activation, and sample acquisition was completed in seconds.

The presence of hydrocodone in Norco® is clearly indicated by peak agreement between sample and SERS library spectra. (Figure 2).

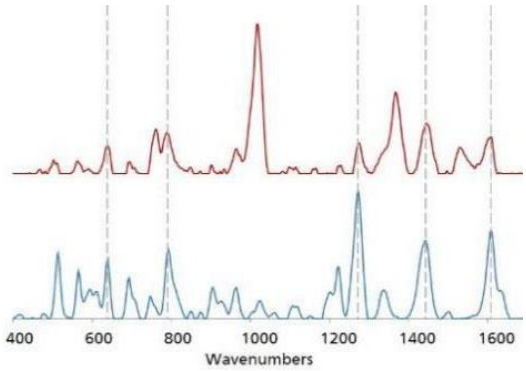


Figure 2. The gold SERS spectrum of Norco® (red), is overlaid with a gold SERS library spectrum of hydrocodone (blue). Dotted lines indicate peak agreement between the two spectra.

RESULTS AND DISCUSSION

This application is an excellent illustration of two important functions of the MIRA DS handheld Raman system. A good way to characterize Raman sampling is, «If you can see it, Raman can identify it.» Raman also excels at through-container sampling, meaning that information about a material can be collected with no sample contact. This may not be crucial for a sample like Norco®, but during encounters with synthetic opioids, which can be deadly in microdoses, it is essential.

In contrast, SERS is used primarily as a method for detection of trace materials or contaminants in a larger sample. SERS can also be used to study materials in a sample that would otherwise fluoresce.

In this application, both the bulk acetaminophen and trace hydrocodone were determined in a single tablet of Norco® using MIRA DS.

CONCLUSION

Dual analysis with Raman and SERS can be an effective tool in the fight against abuse of prescription medications, which is responsible for nearly a third of annual opioid-related deaths. It is also an excellent solution for law enforcement professionals who encounter unknown street drugs containing potentially illegal or even lethal substances.

With Mira DS, one compact instrument can be used—even by non-technicians in the field—to quickly and easily perform both bulk Raman identification and SERS trace analysis with great accuracy.

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