AXES
Antwerp X-ray Analysis,
Electrochemistry & Speciation
University of Antwerp

Portable electrochemical detection of illicit drugs in smuggled samples: towards more secure borders

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PROBLEM → DRUG CONSUMPTION IN SOCIETY

Cocaine

Adults (15-64)

Last year use

4.3 m
1.3 %

Lifetime use

17.9 m
5.4 %

Young adults (15-34)

Last year use

2.9 m
2.4 %

National estimates of use in last year

Lowest 0.2 %

Highest 5.3 %

MDMA

Adults (15-64)

Last year use

2.7 m
0.8 %

Lifetime use

13.6 m
4.1 %

Young adults (15-34)

Last year use

2.3 m
1.9 %

National estimates of use in last year

Lowest 0.2 %

Highest 6.9 %

Amphetamines

Adults (15-64)

Last year use

2.0 m
0.6 %

Lifetime use

12.3 m
3.7 %

Young adults (15-34)

Last year use

1.4 m
1.2 %

National estimates of use in last year

Lowest 0.0 %

Highest 3.0 %

Heroin and other opioids

High-risk opioid users

1.3 million

660 000

opioid users received substitution treatment in 2018

Drug treatment requests

Principal drug in about 34 % of all drug treatment requests in the European Union

34 %

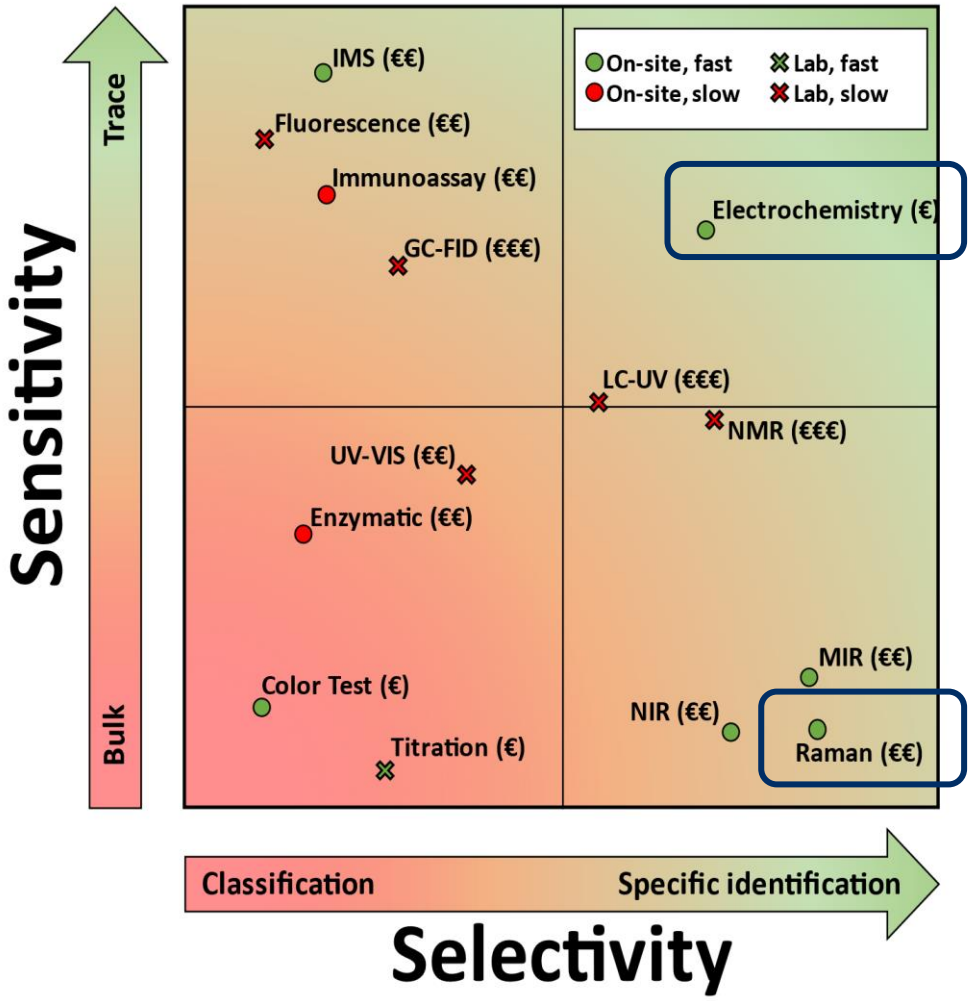
Fatal overdoses

Opioids are found in 82 % of fatal overdoses

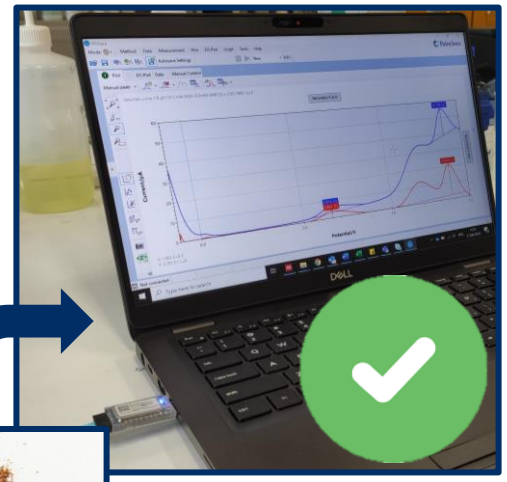
82 %

Source: European drug report: trends and developments. Edition 2020. EMCDDA

SOLUTION: BLOCK DRUG TRACKING & SEIZING IN THE STREET
Current methods (e.g. Raman) exhibit challenges!



Rapid and affordable on-site testing by the use of electrochemical sensors



Bulky and expensive commercial device used at border settings

Building the library: Electrochemical profiling of illicit drugs

Detection of targeted illicit drugs according to its oxidation potential at certain specific conditions

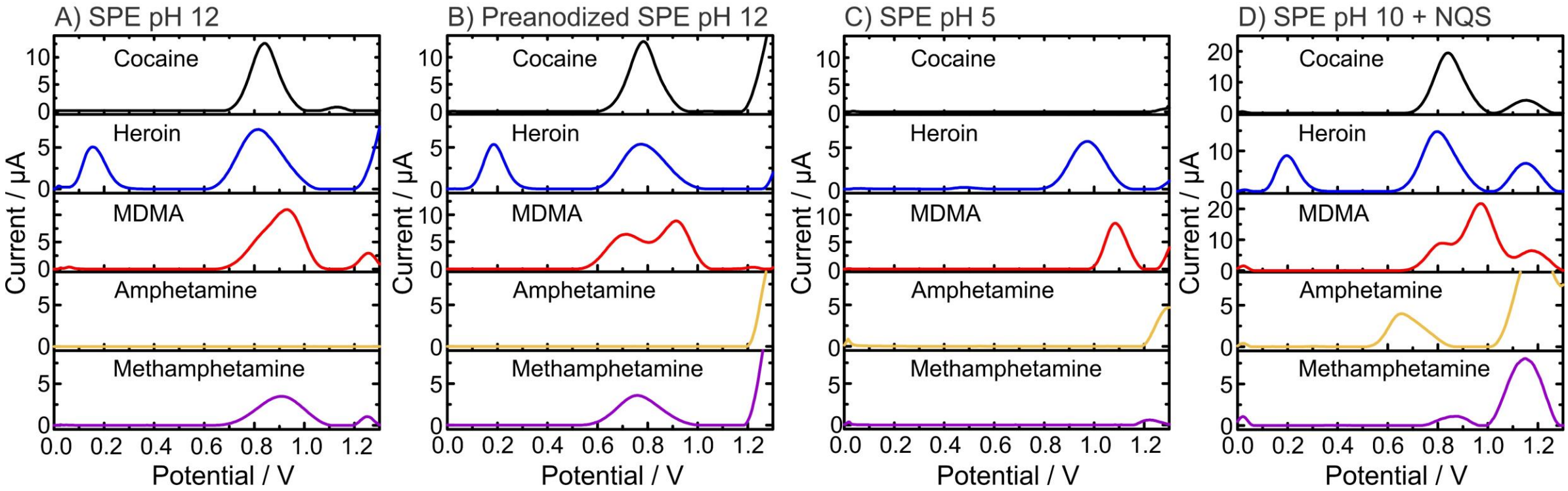


Figure 1. Electrochemical profiles of illicit drugs (0.5 mM) obtained by square-wave voltammetry (SWV) using SPE at different pH: A) pH 12; B) pH 12 using preanodized SPE; pH 5; and pH 10 including the derivatizing agent NQS.

Building the library: Electrochemical profiling of cutting agents

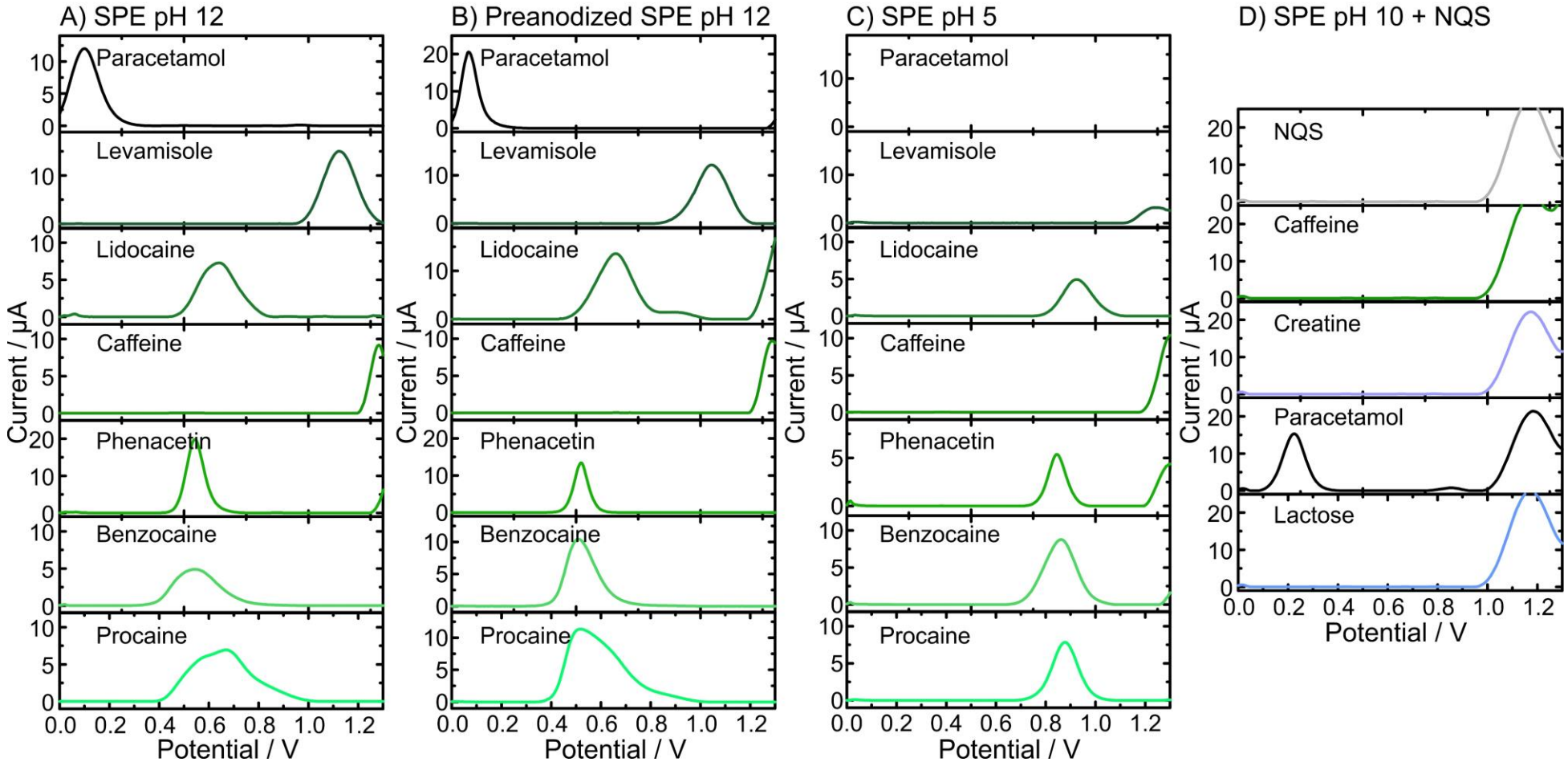


Figure 2. Electrochemical profiles of common cutting agents (0.5 mM) obtained by square-wave voltammetry (SWV) using SPE at different pH: A) pH 12; B) pH 12 using preanodized SPE; pH 5; and pH 10 including the derivatizing agent NQS.

Portable electrochemical device for the on-site detection

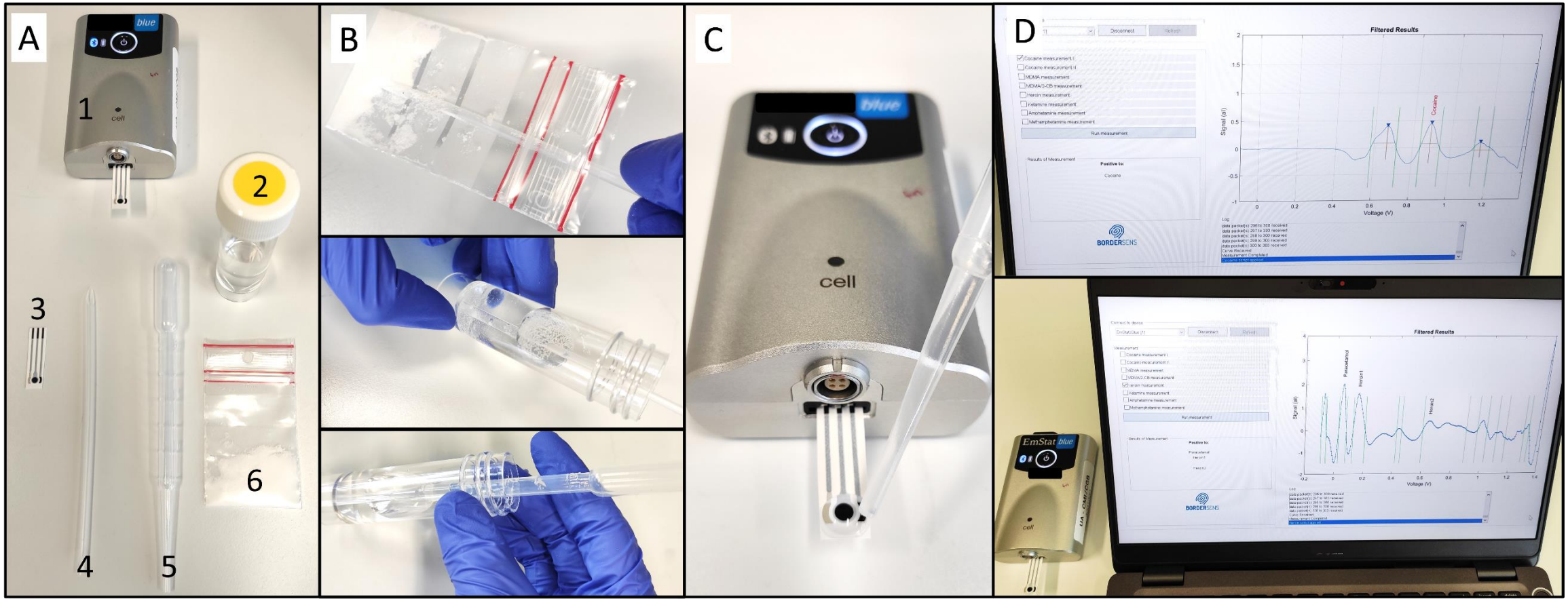


Figure 3. A) Elements of the electrochemical device (1-potentiostat, 2-buffer container, 3-SPE, 4-disposable spatula, 5-disposable pipette, 6-confiscated sample); B) Sampling procedure; C) deposition of the solution on the setup ready for the electrochemical interrogation; and D) user-friendly interface showing the results of the analysis with identification.

Results of the analysis of seized samples.

Seized illicit drug	Accuracy electrochemical device	Accuracy portable Raman
Cocaine (n=10)	100 %	70 %
Heroin (n=10)	100 %	10 %
MDMA (n=10)	100 %	100 %
Amphetamine (n=10)	100 %	20 %

- **Results based on the identification by the peak potential of each illicit drug at certain conditions.**
- **10 seized samples were analyzed for each illicit drug. A total of 40 samples.**
- **The accuracy was calculated according to the GC-MS analysis.**

Conclusions

1. The construction of a library from electrochemical profiles of illicit drugs and common cutting agents at different conditions is performed.
2. Development of a tailor-made script with the integration of the peak potentials of each target for automatic identification.
3. The analysis of 40 confiscated samples from illicit drugs is attained using a portable electrochemical device.
4. The analysis of the confiscated samples is validated by GC-MS and compared with portable Raman commonly used by law enforcement agents.
5. The electrochemical device outperformed the commercial Raman device.

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