Elucidation of the Electrochemical Behavior of Methamphetamine for Its Detection in Confiscated Samples Using a Portable Device

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Introduction

Methamphetamine (MA) is a synthetic psychoactive drug with medical applicability, being prescribed for ADHD and for short-term treatment of obesity. Most frequently though, it is abused for various effects such as hallucinations or euphoria. This behavior is illustrated by the growing spread and abuse of MA, which had the largest increase in quantities seized in the last decade[1]. Hence, the analytical tools used for the screening of suspected cargos by law enforcement agencies play play an important role in the disruption of the illegal distribution of MA. Therefore, the present study took advantage of the highly sensitive and accurate detection provided by the electrochemical methods[2,3], aiming for MA detection in suspected samples by square wave voltammetry (SWV) on disposable graphite screen printed electrodes with a portable device connected to a smartphone.

Conclusions

1 pH 12 proved to be optimal for MA detection which registered an irreversible oxidation peak.

2 two potential zones were identified for MA detection depending on the concentration level.

3 detection in the presence of common adulterants as well as other illicit drugs was achieved.

4 confiscated samples were tested with 100% true positive results.

References

1. European Drug Report 2021: Trends and Developments (DOI: 10.2810/18539).
2. Dragan A-M, et al. Front Chem (DOI: 10.3389/fchem.2021.641147).
3. Parrilla M, et al. Sens Actuators B Chem (DOI: 10.1016/j.snb.2021.129819).

Acknowledgements

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Methodology

SWV parameters: potential range from 5 mV to 1.5 V, step potential of 5 mV, amplitude of 25 mV, frequency of 10.0 Hz.

1 Redox behavior

(i) pH study from 6 to 12;

(ii) characterization by cyclic voltammetry (CV): potential range from -0.2 V to 1.5 V, scan rate of 0.10 V.

2 Analytical parameters

- concentration range: from 50 µm to 10 mM;
- limit of detection (LOD), limit of quantification (LOQ), sensitivity, linearity range.

3 Selectivity study

- equimolar binary mixtures with other illicit drugs and with common adulterants at 2 concentration levels: (i) low (0.5 mM), (ii) high (7.5 mM).

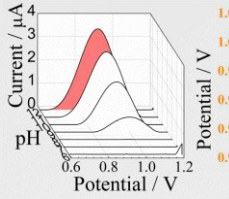
4 Real samples analysis

- sampling methods: (i) underloading; (ii) overloading;
- confiscated samples of MA and other illicit drugs - for (ii);
- comparison with Raman and FTIR portable devices for (ii).

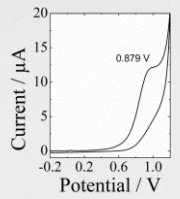
Results and discussions

1 Redox behavior

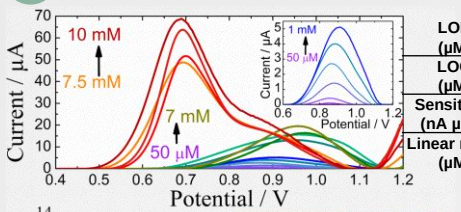
(i) pH study



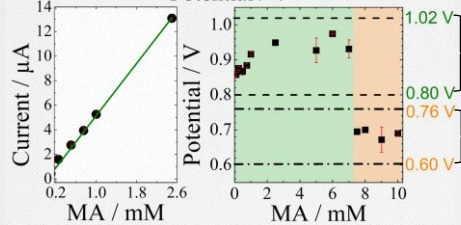
(ii) CV plot



2 Analytical parameters



LOD (µM)	66.4
LOQ (µM)	250
Sensitivity (nA µM^{-1})	5.31
Linear range (µM)	250 - 2500



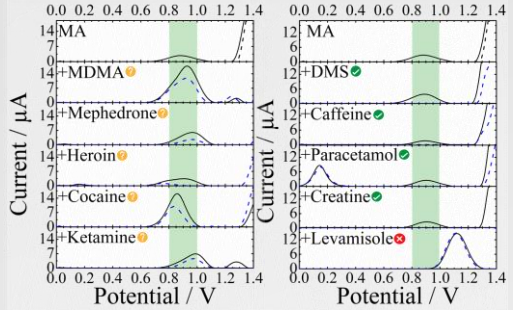
Potential range for identification at low concentration level (0.5 mM)

Potential range for identification at high concentration level (7.5 mM).

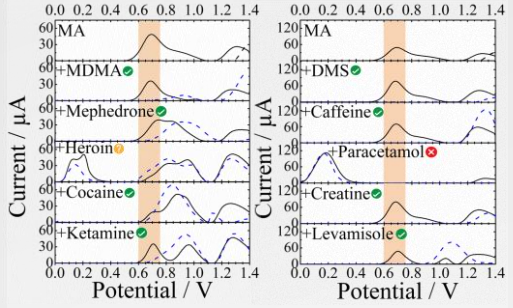
Linearity equation: current (µA)= 5.3081 * [MA] (mM) + 0.1537, R^2 = 0.9996

3 Selectivity study

(i) Low concentration level (0.5 mM)



(ii) High concentration level (7.5 mM)



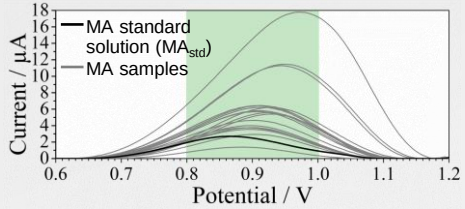
MA / binary mixture adulterant

MA signal detectable MA signal suppressed

MA signal overlapped/shifted

4 Real samples analysis

(i) Underloading



100 % true positive results

(ii) Overloading

(a) MA samples (MA$_s$)

(b) other illicit drugs samples (O$_s$)