APPLICATION OF BIOCHIP ARRAY TECHNOLOGY TO THE SIMULTANEOUS SCREENING OF DRUGS FROM A SINGLE HAIR SAMPLE USING THE BIOCHIP ANALYZER EVIDENCE INVESTIGATOR

RANDOX TOXICOLOGY

P. Sinha | Randox Laboratories-US Ltd. 515 Industrial Boulevard, Kearneysville , VA 25430, USA | Randox Toxicology Ltd. 55 Diamond Road, Crumlin, Co Antrim, BT29 4QY, UK | e-mail: scientific.publications@randox.com

Introduction

Biochip array technology enables the simultaneous detection of multiple analytes from a single sample, which increases the screening capacity during the drug testing process.

The collection of hair samples is non-invasive and the use of this matrix for drug testing, provides a large window of detection as well as the history of drug exposure over time for an individual. Society of Hair Testing (SoHT) and European Workplace Drug Testing Society (EWDTS) guidelines for drug testing in hair are in place.

This presentation provides results from the evaluation of this new application that allows simultaneous screening of multiple drugs: amphetamine, benzodiazepines, benzoylecgonine/cocaine, cannabinoids, hydrocodone, ketamine, methamphetamine, opiates, oxymorphone and phencyclidine from a single hair sample using the semi-automated biochip analyzer Evidence Investigator.

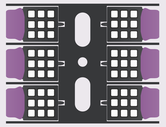
Simultaneous immunoassays arrayed on the biochip surface allow this multi-analytical approach, which leads to test consolidation and an increase in the screening capacity in test settings.

Methodology

Competitive chemiluminescent biochip-based immunoassays were employed. Ligands were immobilized and stabilized onto the biochip surface defining an array of discrete test sites. The signal output is inversely proportional to the concentration of drug in the sample.

The immunoassays were applied to the biochip analyzer Evidence Investigator. With this system 54 biochips can be handled at a time.

Biochip Carrier with 9 Biochips



Biochip Handling Tray with 6 Carriers

Semi-Automated Analyzer Evidence Investigator

The extraction of the drugs from hair samples (50 mg) involved:

→ Washing with ddH2O and then with dichloromethane.

↓

After drying, addition of zirconia pulverising beads.

← Following spinning and pulverisation, methanol was added.

↓

After decantation and drying, the reconstituted sample was added to the biochip.

The total assay time including wash, extraction and assay, was 12 hours.

Results

Cut-offs and Limit of Detection (LOD)				
Assay	Amphetamine	Benzodiazepines	Benzoylecgonine/Cocaine	Δ9-THC
Equivalent Cut-off (ng/mg)	0.04	0.01	0.1	0.01
Equivalent LOD (ng/mg)	0.024	0.004	0.007	0.005
Assay	THC-COOH	Hydrocodone	Ketamine	Methamphetamine
Equivalent Cut-off (ng/mg)	0.001	0.04	0.5	0.15
Equivalent LOD (ng/mg)	0.0005	0.003	0.195	0.051
Assay	Opiates	Oxymorphone	Phencyclidine	-
Equivalent Cut-off (ng/mg)	0.04	0.1	0.02	-
Equivalent LOD (ng/mg)	0.002	0.004	0.005	-

Cut-offs SOHT and EWDST				
Cut-off (ng/mg)	Amphetamine	Benzodiazepines	Benzoylecgonine/Cocaine	Δ9-THC
SOHT	0.2	N/A	0.5	0.05
EWDST	0.2	0.05	0.5	0.05
Cut-off (ng/mg)	THC-COOH	Hydrocodone	Ketamine	Methamphetamine
SOHT	0.0002	N/A	N/A	0.2
EWDST	0.0002	N/A	0.5	0.2
Cut-off (ng/mg)	Opiates	Oxymorphone	Phencyclidine	-
SOHT	0.2	N/A	N/A	-
EWDST	0.2	N/A	N/A	-

Inter-assay precision	Recovery range (%)
-50% cut-off, cut-off and +50% cut-off	-50% cut-off, cut-off and +50% cut-off
All assays: CV (%) ≤17	80-129

Sample assessment: 92 outsourced authentic samples (negative and confirmed positive samples)	
Assay	Agreement (%)
Amphetamine	95.7
Benzodiazepines	87.8
Benzoylecgonine/cocaine	95.5
THC	93.5
Hydrocodone	100
Ketamine	100
Methamphetamine	96.7
Opiates	97.8
Oxymorphone	100
Phencyclidine	100

19.020, .027, 033.156RDFT

Conclusion

Biochip array technology is applicable to the simultaneous screening of drugs from a single hair sample.

For drugs appearing in the SoHT or EWDTS guidelines:
Cut-offs with the biochip platform were lower for amphetamine, benzodiazepines, benzoylecgonine/cocaine, Δ9-THC, methamphetamine and opiates indicating high sensitivity.

Favourable agreement in the assessment of authentic samples.

With the Evidence Investigator multiple samples can be assessed at a time (up to 54 biochips can be handled at the same time) which increases even further the screening capacity.