Analysis of Psychotropic Drugs in Human Hair Using Gas Chromatography-Mass Spectrometry.

Breidi S.E.[1], Barker J.[1], Petroczi A.[2], Naughton D.P.[2]

[1] School of Pharmacy and Chemistry, Kingston University, London, UK

[2] School of Life Sciences, Kingston University, London, UK

Background: Hair testing for drugs of abuse is a developing technique that offers the possibility of a longer detection window than is commonly obtained from urine or blood analysis. The aim of this study is to develop a method for analysis of Delta-9-tetrahydrocannabinol (Δ9-THC) in hair samples using an ELISA screening procedure followed by confirmation using Gas Chromatography–Mass Spectrometry (GC–MS).

Methods: 50 mg of hair from 20 athlete participants was hydrolysed by a newly-improved enzymatic technique using Proteinase K to dissolve hair strands. This enzymatic hydrolysis method is an improvement over other approaches, which could easily cause drug degradation in the presence of NaOH and HCl along with high temperatures. These samples were extracted and screened by a qualitative, competitive type of ELISA read by Cary 50 MPR microplate reader and subjected to confirmation analysis by 7890A AGILENT TECH gas chromatography, in combination with an AGLINET 5975 XL EI/CI MSD Triple Axis Detector mass spectrometer.

Results: New, highly sensitive, specific, reproducible and reliable GC–MS method were developed to detect very low levels of THC in human hair without derivatisation to confirm these ELISA results. 18 out of 20 were positive by ELISA for THC. ELISA results showed a lack of specificity, although this assay is capable of detecting 100 pg of THC per mg of hair, GC-MS was also capable of detecting lower values (20pg/mg hair). This proves the unexpectedly 18 false positive results which were clear samples when investigated and confirmed by GC-MS. Recovery after comparison of the extracted neat compound with the spiked hair was 78%. The GC-MS method was validated for the lower limit of detection (LLOD) 10pg/mg, LLOQ 20pg/mg, interday precision, intraday precision, specificity, extraction recovery, linearity and accuracy.

Conclusion: These newly developed methods for drug analysis in hair accompany urine and blood analysis and improve drug analysis techniques. Although the limits of detection for blood sample is the same or slightly better (0.4ng/ml), the advantages of hair analysis are the non-invasiveness, negligible risk of infection and easy sample storage & collection. There is also a reduced risk of tampering and cross-contamination of samples. The wide detection

window of underivatised drugs samples by GC-MS and the stability of drugs using new enzymatic hydrolysis techniques may also offer an alternative, competitive method of analysis. These results demonstrate the difficulties encountered in using ELISA based methods for hair analysis.

References:

1. Rosa C, and Sue P, Simultaneous quantification of opiates, amphetamines, cocainenext term and metabolites and diazepam and metabolite in a single hair sample using GC–MS, Journal of Chromatography B, Volume 850, Issues 1-2, 1 May 2007, Pages 423-431

2. Michel Y, Mersch F and Wennig R, Detection of benzodiazepines and other psychotropic drugs in human hair next term by GC/MS ,Forensic Science International ,Volume 84, Issues 1-3, 17 January 1997, Pages 211-218

3. M. Uhl, Determination of drugs in hair using GC/MS/MS, Forensic Science International, Volume 84, Issues 1-3, 17 January 1997, Pages 281-294

Acknowledgement: I want to thank my Supervisors Dr. James Barker, Prof. Declan Naughton and Prof. Andrea Petroczi for their detailed and constructive comments, and for their important support throughout this work. Also i would like to thank Mr. Ihsan Sari for data and hair samples collection.