The 2007 “Research on Drug Evidence” Report

[From the 15th ICPO / INTERPOL Forensic Science Symposium]

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ABSTRACT: A reprint of the 2007 “Research on Drug Evidence” Report (a review) is provided.

KEYWORDS: INTERPOL, Illicit Drugs, Controlled Substances, Forensic Chemistry.

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The “General Overview” (Talking Paper) was removed from this reprint (Editor’s discretion).

This reprint is derived from the original electronic document, and is not an image of the best available hard copy (as was utilized for the 1995 and 1998 reports). For this reason, the pagination in the Proceedings is not retained in this reprint; in addition, minor corrections were made, (where present) "contact information" was removed, and some minor reformatting was done to eliminate deadspace. All widow and orphan lines were left as is. The references in this review were not numbered in the original document. The journal titles may be in complete or abbreviated forms, and the listed page(s) may be only the first page or the entire range (the titles and page(s) duplicate what was provided in the respective abstract).
Research On Drug Evidence
July 1, 2004 - June 30, 2007

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Fifteenth ICPO - INTERPOL
Forensic Sciences Symposium
October, 2007

Lyon, France
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Notes:  
1. All categories are subdivided by topic or category, then alphabetically by the first author's last name.  
2. Where appropriate, a short explanatory note is added to the citation to provide additional detail concerning the reference.  
3. Note that the following reference is law enforcement restricted, and is not available to the general public: The *Journal of the Clandestine Laboratory Investigating Chemists Association* (all years).
I) **Routine and Improved Analysis of Abused Substances**

**Issue:**
Improved methods of analysis, i.e., faster, more discriminatory, more sensitive, less costly, etc., are needed for all abused substances. Additionally, standard analytical data are required for previously unknown or rarely encountered substances and/or new homolog or analog (i.e., "designer"-type) drugs.

**Solution:**
Drug seizures and clandestine laboratory operations are continuously monitored to provide a comprehensive overview of new developments. Ongoing research in the forensic community, as well as in the general field of analytical chemistry, provide new and/or improved methods of analysis for both routine and specialized analyses of seized drugs. Reports providing standard analytical data for new drugs of abuse and/or improved analytical protocols for known drugs of abuse are generated for the forensic and enforcement communities.

**References:**

**Reviews:**


Almirall JE. Forensic chemistry education. Analytical Chemistry 2004;77(3):69A. [An overview, including projected future needs.]


Cole M. Drugs of abuse. Crime Scene to Court 2004;293.

survey of unusual designer drugs (tablets) obtained at Dutch "smartshops". Primary drugs included 2C-B, 2C-T-2, and 2C-T-7. Includes social commentary and recommendations.]


Fitsev IM, Blokhin VK, Budnikov GK. Chromatographic techniques in forensic chemical examinations. Journal of Analytical Chemistry (Translation of Zhurnal Analiticheskoi Khimii) 2004;59(12):1171. [A minor review. (Unspecified) psychoactive drugs are discussed.]


**Amphetamine, Methamphetamine, and Dimethylamphetamine (see also Substituted Amphetamines, Phenethylamines, and Methylenedioxyamphetamines):**


Katainen E, Elomaa M, Laakkonen U-M, Sippola E, Niemela P, Suhonen J, Jarvinen K. Quantification of the amphetamine content in seized street samples by Raman spectroscopy. Journal of Forensic Sciences 2007;52(1):88. [The results were favorably compared against LC.]


Knops LA, Northrop DM, Person EC. Capillary electrophoretic analysis of phosphorus species in clandestine methamphetamine laboratory samples. Journal of Forensic Sciences 2006;51(1):82. [Presents a CE technique that can separate a wide variety of anions (18 listed), including various phosphorus species, in illicitly prepared methamphetamine samples.]


Moore KA. Amphetamine/sympathomimetic amines. Principles of Forensic Toxicology


Paul BD, Jemionek J, Lesser D, Jacobs A, Searles DA. Enantiomeric separation and quantitation of (+/-)-amphetamine, (+/-)-methamphetamines, (+/-)-MDA, (+/-)-MDMA, and (+/-)-MDEA in urine specimens by GC-EI-MS after derivatization with (R)-(−) or (S)-(+) alpha-methoxy-alpha-(trifluoromethyl)phenylacetyl chloride (MTPA). Journal of Analytical Toxicology 2004;28(6):449.


Sachs SB, Woo F. A detailed mechanistic fragmentation analysis of methamphetamine and select regioisomers by GC/MS. Journal of Forensic Sciences 2007;52(2):308. [Includes methamphetamine and 7 related compounds.]


Tomaszewski W, Gun'ko VM, Leboda R, Skubiszewska-Zieba J. Interaction of
amphetamine and its N-alkyl-substituted derivatives with micro- and mesoporous adsorbents in polar liquids. Journal of Colloid and Interface Science 2004;282(2):261. [The title technique is used to concentrate amphetamines from "dilute aqueous solutions" (may be biological fluids - not clear in abstract).]


Wu TY, Fuh MR. Determination of amphetamine, methamphetamine, 3,4-methylenedioxyamphetamine, 3,4-methylenedioxyethylamphetamine, and 3,4-methylenedioxy-methamphetamine in urine by online solid-phase extraction and ion-pairing liquid chromatography with detection by electrospay tandem mass spectrometry. Rapid Communications In Mass Spectrometry 2005;19(6):775.


**Barbiturates:**


Ghanem A. True and false reversal of the elution order of barbiturates on a bonded cellulose-based chiral stationary phase. Journal of Chromatography A 2006;1132(1-2):329. [With "a set of racemic N-alkylated barbiturates" (not specified in the abstract).]

Grove AA, Rohwer ER, Laurens JB, Vorster BC. The analysis of illicit methaqualone...


**Benzodiazepines:**


Kratzsch C, Tenberken O, Peters FT, Weber AA, Kraemer T, Maurer HH. Screening, library-assisted identification and validated quantification of 23 benzodiazepines,
flumazenil, zaleplone, zolpidem, and zopiclone in plasma by liquid chromatography/mass spectrometry with atmospheric pressure chemical ionization. Journal of Mass Spectrometry 2004;39(8):856. [The focus is toxicological.]


Rao RN, Parimala P, Khalid S, Alvi SN. Detection of the adulteration of traditional alcoholic beverages by the separation and determination of alprazolam, chloral hydrate, and diazepam using reversed phase high performance liquid chromatography. Analytical Sciences 2004;20(2):383. [200 seized samples were analyzed.]


**Clenbuterol:**


Stefan-van-Staden RI, Lai B. Enantioselective, potentiometric carbon paste electrodes based on C-60 derivatives as chiral selectors for the enantioanalysis of S-clenbuterol. Analytical Letters 2006;39(7):1311. [Using three different electrodes, for analysis of both raw material and serum samples.]


**Cocaine:**


Block R. Cocaine base to soup. Journal of the Clandestine Laboratory Investigating Chemists Association 2006;16(3):21. [Reports on the re-analysis of partially decomposed samples of cocaine base that had been stored in metal paint cans for 6 years.]


**Ergot Alkaloids** (see also LSD):


Lehner AF, Craig M, Fannin N, Bush L, Tobin T. Electrospray [+] tandem quadrupole mass spectrometry in the elucidation of ergot alkaloids chromatographed by HPLC:


Mohamed R, Gremaud E, Richoz-Payot J, Tabet JC, Guy PA. Quantitative determination of five ergot alkaloids in rye flour by liquid chromatography - electrospray ionisation tandem mass spectrometry. Journal of Chromatography A 2006;1114(1):62. [The target alkaloids were ergocristine, ergotamine, ergonovine, ergocornine, and ergokryptine; 15 samples of rye flour were analyzed.]


Fentanyl(s):


Drug Enforcement Administration (DEA), U.S. Department of Justice. Control of a
chemical precursor used in the illicit manufacture of fentanyl as a List I chemical. Interim rule with request for comments. Fed Regist 2007;72(77):20039-47.


**Flos daturae:**


Hou SG, Gu XX, Wang SY, Li HX. [Determination of scopolamine and atropine in Flos


**Fluoxetine (Prozac):**


**Heroin:**


standards and illicit samples.]

Beckerleg S, Telfer M, Sadiq A. A rapid assessment of heroin use in Mombasa, Kenya. Substance Use & Misuse 2006;41:1029. [Presents the title survey, done in March, 2004. 496 Heroin users were interviewed.]


Macchia M, Bertini S, Mori C, Orlando C, Papi C, Placanica G. Efficient application of monolithic silica column to determination of illicit heroin street sample by HPLC. Farmaco 2004;59(3):237. [Presents the title analysis (complete in 7 minutes).]

Ren J, Gao J-z, Suo N, Zhao G-h, Yang W, Lue D-y, Sun K-j, Li C-y. Determination of heroin based on analyte pulse perturbation to an oscillating chemical reaction. Chemical Research in Chinese Universities 2004;20(5):534. [For trace level detection of heroin. The application(s) for the technique were not reported in the abstract.]


gamma-Hydroxybutyric Acid (GHB), gamma-Butyrolactone (GBL) and 1,4-Butanediol (BD):

Bell SC, Oldfield LS, Shakleya DM, Petersen JL, Mercer JW. Chemical composition and structure of the microcrystals formed between silver(I) and gamma-hydroxybutyric acid

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DeFrancesco JV, Witkowski MR, Ciolino LA. GHB free acid: I. Solution formation studies and spectroscopic characterization by 1HNMR and FT-IR. J Forensic Sci 2006;51(2):321-9.  [The technique is suitable for analysis of forensic samples containing the free acid, its corresponding salt, and GBL.]

Del Signore AG, McGregor M, Cho BP. 1H NMR analysis of GHB and GBL: Further findings on the interconversion and a preliminary report on the analysis of GHB in serum and urine. Journal of Forensic Sciences  2005;50(1):81.  [Spiked samples are included. Focus is toxicological, but the results are pertinent for spiked beverages.]

Elliott S, Burgess V. The presence of gamma-hydroxybutyric acid (GHB) and gamma-butyrolactone (GBL) in alcoholic and non-alcoholic beverages. Forensic Science International  2005;151(2-3):289.


Hennessy SA, Moane SM, McDermott SD. The reactivity of gamma-hydroxybutyric acid (GHB) and gamma-butyrolactone (GBL) in alcoholic solutions. Journal of Forensic Sciences  2004;49(6):1220.  [Presents a study of the formation of esters of GHB, with an emphasis on the formation of the ethyl ester in alcoholic beverages.]

Marinetti LJ, Isenschmid DS, Hepler BR, Kanluen S. Analysis of GHB and 4-methyl-GHB in postmortem matrices after long-term storage. Journal of Analytical
Matsuda K, Asakawa N, Iwanaga M, Gohda A, Fukushima S, Ishii Y, Yamada H. Conversion of gamma-hydroxybutyric acid to a fluorescent derivative: A method for screening. Forensic Toxicology 2006;24(1):41. [GHB is converted to a fluorescent derivative using 3-bromomethyl-6,7-dimethoxy-1-methyl-1,2-dihydroquinoxaline-2-one. The focus is toxicological, but analysis of powdered and tableted forms of GHB is specifically mentioned in the abstract.]

Mercer JW, Oldfield LS, Hoffman KN, Shakleya DM, Bell SC. Comparative analysis of gamma-hydroxybutyrate and gamma-hydroxyvalerate using GC/MS and HPLC. Journal of Forensic Sciences 2007;52(2):383. [GHB and GHV were derivatized with BSTFA with trimethylchlorosilane prior to GC/MS analyses. UV/Vis detection at 254 nm was used for the HPLC analyses.]


Sabucedo AJ, Furton KG. Extractionless GC/MS analysis of gamma hydroxybutyrate
and gamma butyrolactone with trifluoroacetic anhydride and heptafluoro-1-butanol from aqueous samples. Journal of Separation Science 2004;27(9):703. [Presents a novel technique for the derivatization and analysis of the title compounds directly from dilute aqueous solutions (i.e., beverages).]


Zhang SY, Huang ZP. [A color test for rapid screening of gamma-hydroxybutyric acid (GHB) and gamma-butyrolactone (GBL) in drink and urine]. Fa Yi Xue Za Zhi 2006;22(6):424-7.

**Ketamine:**


Jen HP, Tsai YC, Su HL, Hsieh YZ. On-line preconcentration and determination of ketamine and norketamine by micellar electrokinetic chromatography - Complementary


Khat:


LSD:

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Suzuki S. Lysergic acid diethylamide (LSD). Drugs and Poisons in Humans 2005:225.


**Marijuana and Related Cannabinoids:**


Caligiani A, Palla G, Bernardelli B. GC-MS analysis of hashish samples: A case of adulteration with colophony. Journal of Forensic Sciences 2006;51(5):1096. [In a sample seized in Italy (colophony is the acidic flux used for soldering).]

Carpentier C, Griffiths P, King LA. An overview of cannabis potency in Europe. Report EMCDDA Insights 2004:1. [Also discusses the results versus the comparable data for the United States and Australia/New Zealand.]


Dussy FE, Hamberg C, Luginbuhl M, Schwerzmann T, Briellmann TA. Isolation of delta(9)-THCA-A from hemp and analytical aspects concerning the determination of


Hanson AJ. Specificity of the Duquenois-Levine and cobalt thiocyanate tests substituting methylene chloride or butyl chloride for chloroform. Microgram Journal 2005;3(3-4):183. [Performs the named tests using methylene chloride or butyl chloride as substitutes for chloroform.]

Hazekamp A, Choi YH, Verpoorte R. Quantitative analysis of cannabinoids from Cannabis sativa using H1 NMR. Chemical and Pharmaceutical Bulletin 2004;52(6):718. [Allows analysis of pure cannabinoids or cannabinoid mixtures from plant material in less than 5 minutes, without pre purification.]


Huq S, Dixon A, Kelly K, Kallury KMR. Novel solid-phase extraction protocol for 11-nor-9-carboxy-delta(9)-tetrahydrocannabinol from urine samples employing a polymeric mixed-mode cation-exchange resin, Strata-X-C, suitable for gas chromatography-mass spectrometry or liquid chromatography-mass spectrometry


Moore C, Rana S, Coulter C, Feyerherm F, Prest H. Application of two-dimensional gas chromatography with electron capture chemical ionization mass spectrometry to the


**Methadone:**


**Methylenedioxyamphetamine and Related Compounds:**

Aalberg L, DeRuiter J, Sippola E, Clark CR. Gas chromatographic optimization study on the side chain and ring regioisomers of methylenedioxymethamphetamine. Journal of Chromatographic Science 2004;42(6):293. [Includes the analysis of 10 isomeric compounds (not specified in the abstract).]


Concheiro M, de Castro A, Quintela O, Lopez-Rivadulla M, Cruz A. Determination of


Jiang H-p, Ren C-h. Study on DFT of the structure and property of MDMA molecule. Xihua Daxue Xuebao, Ziran Kexueban 2006;25(5):69 6A. [A theoretical study of the structure and properties of MDMA by the "d. functional theory" ("d." was not defined in the abstract). Written in Chinese.]

Kalasinsky KS, Hugel J, Kish SJ. Use of MDA (the "Love Drug") and methamphetamine in Toronto by unsuspecting users of ecstasy. Journal of Forensic Sciences 2004;49(5):1106. [An overview of the use of alleged MDMA tablets containing mixed and/or alternative drugs, focus is biological/toxicological.]


Koelliker S, Oehme M. Structure elucidation of nanogram quantities of unknown designer drugs based on phenylalkylamine derivates by ion trap multiple mass spectrometry. Analytical and Bioanalytical Chemistry 2004;378(5):1294. [Presents the use of HPLC multiple mass spectrometry on 55 phenylalkylamines (focus is on compounds in European Ecstasy tablets).]


Liu J-T. GC-MS and pentafluoropropionic anhydride derivatization methods for the differentiation of 3,4-methylenedioxyamphetamine (MDMA) from their regioisomeric 1-(3,4-methylenedioxyphenyl)-2-ethylamines (MDPEAs). Huaxue 2005;63(1):95.


Newton HR. Indanylamphetamine identified. Journal of the Clandestine Laboratory Investigating Chemists Association 2004;14(3):12. [Presents analytical data for 1-(5 indanyl)-2-aminopropane (commonly mis-named as "indanylamphetamine"), a recently encountered designer drug that is an analog of MDA.]

Peters FT, Samyn N, Lamers CTJ, Riedel WJ, Kraemer T, De Boeck G, Maurer HH. Drug testing in blood: Validated negative-ion chemical ionization gas chromatographic-mass spectrometric assay for enantioselective measurement of the designer drugs MDEA, MDMA, and MDA and its application to samples from a controlled study with MDMA. Clinical Chemistry 2005;51(10):1811.


Tanner-Smith EE. Pharmacological content of tablets sold as "Ecstasy": Results from an online testing service. Drug Alcohol Depend 2006;83(3):247-54.


**Methylphenidate:**

Gilbert KM, Skawinski WJ, Misra M, Paris KA, Naik NH, Buono RA, Deutsch HM,

**Morphine, Codeine, and Related Opium Alkaloids:**


Kuila DK, Lahiri SC. Interactions of morphine and codeine with benzoic acid and substituted benzoic acids. Journal of the Indian Chemical Society 2004;81(11):928. [Investigates the complexes formed by the title compounds. The focus of this study is not clear from the abstract.]


Liu HC, Ho HO, Liu RH, Yeh GC, Lin DL. Urinary excretion of morphine and codeine following the administration of single and multiple doses of opium preparations prescribed in Taiwan as "brown mixture". J Anal Toxicol 2006;30(4):225-31.


Smetkova M, Ondra P, Lemr K. HPLC-MS and CE-MS with atomospheric pressure ionization in analysis of morphine and related compounds. Chemie Listy 2004;98(6):336. [A review and discussion of the title subject. Not clear whether the focus is forensic or toxicological (the latter appears more likely). Written in Czech.]


Zayed MA, Hawash MF, Fahmey MA. Structure investigation of codeine drug using

**Opiate Alkaloids:**


Li SH, He CY, Liu HW, Li K, Liu F. Ionic liquid-based aqueous two-phase system, a sample pretreatment procedure prior to high-performance liquid chromatography of opium alkaloids. **Journal of Chromatography B - Analytical Technologies in the**
Biomedical and Life Sciences 2005;826(1-2):58.


Qi XH, Mi JQ, Zhang XX, Chang WB. Preparation and application of an immunoaffinity column for direct extraction of morphine and its analogs from opium. Chinese Chemical Letters 2004;15(11):1323. [The presented method uses an IAC for isolation and CE for analysis. The four alkaloids that are selectively isolated are morphine, codeine, dionin, and thebaine.]


**Opium (and Opium Poppies):**


Lenehan CE, Barnett NW, Lewis SW, Essery KM. Preliminary evaluation of dual acidic potassium permanganate and tris(2,2'-bipyridyl)ruthenium(II) chemiluminescence detection for the HPLC determination of Papaver somniferum alkaloids. Australian


**Overview/Polydrug:**


Apollonio LG, Pianca DJ, Whittall IR, Maher WA, Kyd JM. A demonstration of the use
of ultra-performance liquid chromatography-mass spectrometry [UPLC/MS] in the
determination of amphetamine-type substances and ketamine for forensic and

Apollonio LG, Whittall IR, Pianca DJ, Kyd JM, Maher WA. Product ion mass spectra of
amphetamine-type substances, designer analogues, and ketamine using ultra-performance
2006;20(15):2259-64.

Bishop SC, McCord BR, Gratz SR, Loeliger JR, Witkowski MR. Simultaneous
separation of different types of amphetamine and piperazine designer drugs by capillary

Bishop SC. Advanced capillary electrophoretic techniques for the detection of date-rape

Bonato PS, Jabor VAP, de Gaitani CM. Enantioselective analysis of drugs:
Contributions of high-performance liquid chromatography and capillary electrophoresis.

T, O'Neil A. Analysis of drugs-of-abuse and explosives using terahertz time-domain and

Caldwell GW, Yan ZY. Screening for reactive intermediates and toxicity assessment in

Chen Z, Wang Y, Zhao Y, An J, Qi T. Analysis of mixed drugs of abuse by gas

Dahlen J, von Eckardstein S. Development of a capillary zone electrophoresis method
including a factorial design and simplex optimisation for analysis of amphetamine,
amphetamine analogues, cocaine, and heroin. Forensic Science International
2006;157(2-3):93.


directly analyzing trace amount analytes in the water-immiscible solution samples. Xuexiao Huaxue Xuebao 2006;27(5):856. [Abstract specifies cocaine and thebaine. Focus may be toxicological (not clear in abstract). Written in Chinese.]


Laks S, Pelander A, Vuori E, Ali-Toippa E, Sippola E, Ojanpera I. Analysis of street drugs in seized material without primary reference standards. Analytical Chemistry 2004;76(24):7375. [Uses a combination of LC-Time-of-Flight-MS and LC-Chemiluminescence Nitrogen Detection on 21 samples (different drugs). The results were found to be reasonable, with variances from established methods ranging from 4 to 21.
percent, and only one apparent false positive.]


Maurer HH. Multi-analyte procedures for screening for and quantification of drugs in blood, plasma, or serum by liquid chromatography-single stage or tandem mass spectrometry (LC-MS or LGMS/MS) relevant to clinical and forensic toxicology. Clinical Biochemistry 2005;38(4):310.

Maurer HH. Position of chromatographic techniques in screening for detection of drugs or poisons in clinical and forensic toxicology and/or doping control. Clinical Chemistry And Laboratory Medicine 2004;42(11):1310.


Nerkis S, Oruc HH. Determination of amounts of the active substance and added substances in cannabis, heroin, and ecstasy tablets used in Bursa and in the Bursa region. Bagimlilik Dergisi 2006;7(1):11. [21 Cannabis, 55 heroin, and 65 Ecstasy tablet exhibits were characterized by GC/MS and FTIR. Written in Turk.]

Nordgren HK, Holmgren P, Liljeberg P, Eriksson N, Beck O. Application of direct urine LC-MS-MS analysis for screening of novel substances in drug abusers. Journal of


**Pethidine:**

**Phenethylamines (including mixtures of Amphetamines, Methylene dioxy-amphetamines, and Related Compounds):**


Habrdova V, Peters FT, Theobald DS, Maurer HH. Screening for and validated quantification of phenethylamine-type designer drugs and mescaline in human blood plasma by gas chromatography/mass spectrometry. Journal of Mass Spectrometry


Thigpen A, Deruiter J, Clark CR. GC-MS Studies on the regioisomeric 2,3- and 3,4-methylenedioxyphenethylamines related to MDEA, MDMMA, and MBDB. J Chromatogr Sci 2007;45(5):229-35.


Piperazines:


analytical data for BZP and TFMPP.]


**Polydrug:**

Conemans JMH, Van Der Burgt AAM, Van Rooij JML, Pijnenburg CC. The simultaneous determination of illicit drugs with HPLC-DAD. Bull TIAFT 2004;34(1):11. [The presented method is applied to drug powders, various dosage forms, and various biological matrices, in a clinical setting.]


Magnuson EE, Burnett LJ. Screening system for detection of contraband swallowed narcotics. Applied Magnetic Resonance 2004;25(3-4):567. [Presents a nonimaging, low-frequency NMR technique to detect pellets of heroin or cocaine.]


**Propoxyphene:**


**Psilocybin Mushrooms, Psilocybin, and Psilocin:**


Rodriguez-Cruz SE. Analysis and characterization of psilocybin and psilocin using liquid chromatography - electrospray ionization mass spectrometry (LC-ESI-MS) with collision induced dissociation (CID) and source induced dissociation (SID). Microgram Journal 2005;3(3-4):175.


**Salvia divinorum:**


Wolowich WR, Perkins AM, Cienki JJ. Analysis of the psychoactive terpenoid
salvinorin A content in five Salvia divinorum herbal products. Pharmacotherapy 2006;26(9):1268. [Analyses were conducted using HPLC and TLC/GC/MS. The samples were purchased from Internet and "Head Shops." The samples were all subpotent with respect to stated Salvinorin A content, and three also contained unreported adulterants.]

**Scopolamine:**


**Steroids:**


Blackledge RD. The identification of 1-dehydromethandrostenolone. Microgram Journal 2005;3(3-4):186. [A recent steroid seizure was identified by GC/MS as 1-dehydromethandrostenolone, a positional isomer of methyltestosterone.]


Mateus Avois L, Mangin P, Saugy M. Use of ion trap gas chromatography-multiple mass


Thevis M, Bommerich U, Opfermann G, Schaezter W. Characterization of chemically modified steroids for doping control purposes by electrospray ionization tandem mass

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Van Thuyne W, Delbeke FT. Validation of a GC-MS screening method for anabolizing agents in solid nutritional supplements. Biomedical Chromatography 2004;18(3):155. [Includes analyses of testosterone, nandralone, stanazolol, metandienone, and various prohormones.]


**Tryptamines (see also Psilocybin):**


Vorce SP, Sklerov JH. A general screening and confirmation approach to the analysis of designer tryptamines and phenethylamines in blood and urine using GC-EI-MS and HPLC-electrospray-MS. Journal of Analytical Toxicology 2004;28(6):407. [Presents the analysis of the pentafluoropropionic derivatives of the title drugs, focus is on biological matrices.]

Wilson JM, McGeorge F, Smolinske S, Meatherall R. A "Foxy" intoxication. Forensic Science International 2005;148(1):31. [Focus is toxicological, but includes mass spectra for the title compound (N,N-diisopropyl-5-methoxytryptamine, also known as "Foxy-Methoxy") and N,N-diisopropyl-5-hydroxytryptamine. Note that there are some nomenclature problems in this article, and the structure and term 5-ethoxy-diisopropyl-tryptamine are incorrectly used in several instances.]


Zaleplon:


**Zolpidem:**

Kelani KM. Selective potentiometric determination of zolpidem hemitartrate in tablets and biological fluids by using polymeric membrane electrodes. Journal of the AOAC International 2004;87(6):1309. [Using four different polymeric membrane sensors.]


**Miscellaneous:**


Kim SC, Chung H, Lee SK, Park YH, Yoo YC, Yun Y-P. Simultaneous analysis of d-3-methoxy-17-methylmorphinan and l-3-methoxy-17-methylmorphinan by high pressure liquid chromatography equipped with PDA. Forensic Science International 2006;161(2-3):185. [The title compounds are dextromethorphan and levomethorphan. The technique used a chiral column. 32 confiscated samples were analyzed.]

Kuila DK, Muhkopadhyay B, Lahiri SC. Identification and estimation of methaqualone in toffee samples using gas chromatography - mass spectrometry, Fourier transform infrared spectroscopy, and high-performance thin-layer chromatography. Forensic Science Communications 2006;8(4):(No Page Numbers). [Presents the analysis of some Indian brand toffee samples suspected to contain adulterants/hypnotic drugs and alcohol. Note that FSC is an on-line journal.]


Neuvonen K, Neuvonen H, Fulop F. Effect of 4-substitution on psychotomimetic activity of 2,5-dimethoxyamphetamine as studied by means of different substituent parameter


Simonov EA, Salomatin VE. Preliminary analysis of substances of unknown origin and complex medicinal formulations. Mikroelementy y Meditsine 2005;6(3):35. [Abstract is unclear as to what technique is used. "Narcotic materials and psychotropic substances" are mentioned. Written in Russian.]


synthetic illicit drugs.]


Yuan X, Forman BM. Detection of designer steroids. Nuclear Receptor Signaling 2005;3:(No Page Numbers Listed). [Presents an analytical strategy that detects use of unknown designer steroids "without prior knowledge of their existence". Focus is toxicological (testing of athletes).]
II) Synthesis and/or Cultivation of Abused Substances, their Precursors, and Essential Chemicals

Issue:
Forensic chemists must maintain familiarity with existing and new clandestine syntheses of abused substances, their precursors, and essential chemicals, and with the cultivation of abused natural products, in order to assist enforcement activities, to ensure safety and effectiveness during enforcement operations, and to provide expert testimony in legal proceedings.

Solution:
Illicit drug seizures, clandestine laboratory operations, and illicit grow operations, are continuously monitored to maintain a comprehensive overview of the field. In cases where new drugs are synthesized, or new methodologies are utilized, case reports are generated for the forensic and enforcement communities.

References:

Production of Abused Substances and/or their Precursors and Essential Chemicals:


Brandt SD, Freeman S, McGagh P, Abdul-Halim N, Alder JF. An analytical perspective on favoured synthetic routes to the psychoactive tryptamines. Journal of Pharmaceutical and Biomedical Analysis 2004;36(4):675. [Appears to be a review, focusing on the probable impurities and marker compounds resulting from common illicit syntheses.]

Brandt SD, Freeman S, Fleet IA, Alder JF. Analytical chemistry of synthetic routes to psychoactive tryptamines - Part III. Characterisation of the Speeter and Anthony route to N,N-dialkylated tryptamines using CI-IT-MS-MS. Analyst 2005;130(9):1258.


Karpiesiuk W, Lehner AF, Hughes CG, Tobin T. Preparation and chromatographic characterization of tetrahydrogestrinone, a new "designer" anabolic steroid. Chromatographia 2004;60(5-6):359. [The synthesis of THG from gestrinone is reported.]


Poortman-Van Der Meer A. The synthesis of MDMA with NaBH4 as the reducing agent; the "Cold Method." Journal of the Clandestine Laboratory Investigating Chemists Association 2006;16(3):10. [Details withheld in accordance with Microgram policy.]


Tadeusiak EJ. Synthesis of phosphonic analogues of carnitine and gamma-amino-


Xu YZ, Chen CP. Synthesis of deuterium labeled phenethylamine derivatives. Journal of Labelled Compounds & Radiopharmaceuticals 2006;49(13):1187. [For use as internal standards in GC/MS. Compounds included 2C-B, 2C-C, 2C-I, 2C-T-2, and 2C-T-7.]


Zvilichovsky G, Gbar-Haj-Yahia I. Birch reduction of (-)-ephedrine formation of a new,

III) Clandestine Laboratories - Appraisals and Safety

Issue:
Forensic chemists must maintain familiarity with clandestine laboratory procedures, setups, and techniques in order to assist enforcement activities, to ensure safety and effectiveness during enforcement operations, and in order to provide expert testimony in court proceedings.

Solution:
Clandestine laboratory operations are continuously reviewed to provide a comprehensive overview of the field. In cases where new methodologies are noted, or unusual safety concerns are salient, reports are generated for the forensic and enforcement communities.

References:

Clandestine Laboratory Appraisals and Safety:


Safety Issues - Case Reports:

Sudakin DL. Occupational exposure to aluminum phosphide and phosphine gas? A

**Miscellaneous:**


--------- Next Section Moved Up to Reduce Deadspace ---------

**IV) Reference Drug Standards and Total Syntheses**

**Issue:**
Many reference drug standards or structurally related internal standards are either commercially unavailable, or if available are extremely expensive.

**Solution:**
Controlled substances and their structural or isotopically labelled analogs are synthesized as needed. Internal standards are also prepared as needed. Case reports are published for new or unusual standards or improved synthetic approaches.

**References:**


V) **Source Determination of Drugs (Impurity Profiling) and Comparative Analyses**

**Issues:**
Impurity profiling of drugs is important for comparative analysis protocols, geo-sourcing, and synthetic route determinations. However, although certain drugs have been well characterized with respect to their impurity profiles, most have not been properly investigated.

Comparative analysis (i.e., the systematic application of impurity profiling for determination of commonality of origin) is complicated due to both the high complexity of the data and the large numbers of exhibits. Improved analytical and data handling techniques are needed.

**Solution:**
High sensitivity analytical techniques (primarily chromatographic) provide detailed profiles of trace-level impurities, ions, trace metals, and stable isotopes. Identification of individual impurities enhance origin identification and comparative analyses and also aid in development of internal standards for improved accuracy and precision of analysis.

In-depth analysis via improved instrumental methodologies help identify discriminatory components in impurity profiles. Computer databases, sorting programs, and pattern recognition/neural networks provide enhanced data handling and analysis, enabling and improving comparative analyses. Case reports are generated for the forensic and enforcement communities.

**References:**

**Amphetamine(s):**


Goldmann T, Taroni F, Margot P. Analysis of dyes in illicit pills (amphetamine and derivatives). Journal of Forensic Sciences 2004;49(4):716. [Analysis for 14 dyes present in European ecstasy tablets is performed using SPE followed by TLC and/or CEC DAD, the results can be used to link cases.]


Poortman-Van der Meer A, Lock E. Identification of 4-tert-butylamphetamine in clandestine amphetamine samples. Journal of the Clandestine Laboratory Investigating Chemists Association 2006;16(2):23. [The title compound results from the presence of 4- tert-butylphenylacetone as an impurity in phenylacetone possibly produced in eastern Europe.]

Cocaine:


**Cocaine and Heroin:**


Morley SR, Hall CJ, Forrest ARW, Galloway JH. Levamisole as a contaminant of illicit cocaine. Journal of the Clandestine Laboratory Investigating Chemists Association 2006;16(4):11. [Focus is on detection in body fluids of cocaine abusers (including six who were deceased) acquired over a 20 week period in the United Kingdom.]


**Heroin:**

Al-Amri AM, Smith RM, El-Haj BM, Juma'a MH. The GC-MS detection and characterization of reticuline as a marker of opium use [Erratum]. Forensic Science International 2004;142(1):59. [Provides a correction to the original article, published 2004;140(2-3):175.]


Casale J, Casale E, Collins M, Morello D, Cathapermal S, Panicker S. Stable isotope analyses of heroin seized from the merchant vessel Pong Su. Forensic Sciences 2006;51(3):603. [See the next citation for the associated lead article on this seizure. The title exhibits were determined to be unique with respect to their origin.]

Collins M, Casale E, Hibbert DB, Panicker S, Robertson J, Vujic S. Chemical profiling of heroin recovered from the North Korean merchant vessel Pong Su. Journal of Forensic Sciences 2006;51(3):597. [The heroin was classified as "unknown" in origin (that is, having a profile that did not resemble any known heroin types).]


Odell LR, Skopec J, McCluskey A. A 'cold synthesis' of heroin and implications in heroin signature analysis utility of trifluoroacetic/acetic anhydride in the acetylation of morphine. Forensic Sci Int 2006;164(2-3):221-9. [Focuses on the impurity profile of heroin produced by this unusual route. Several trifluoroacetyl derivatives were identified, but were also found to be sensitive to typical heroin signature workup and analysis procedures.]

Toske SG, Cooper SD, Morello DR, Hays PA, Casale JF, Casale E. Neutral heroin impurities from tetrahydrobenzylisoquinoline alkaloids. Journal of Forensic Sciences 2006;51(2):308. [Four of the title compounds (laudanosine, reticuline, codamine, and laudanine), all naturally occurring in opium, form 18 detectable neutral impurities under typical heroin processing conditions. These latter impurities were found to be useful for sourcing illicit heroin.]

Zamir A, Cohen Y, Azoury M. DNA profiling from heroin street dose packages. Journal of Forensic Sciences 2007;52(2):389. [DNA could be recovered from fingerprints along the "amorphic" burnt edges of the plastic wrap typically used to package street-level doses of heroin in Israel.]


Zhang ZY, Yang JH, Ouyang H, Li ZJ, Chai ZF, Zhu J, Zhao JZ, Yu ZS, Wang J. Study of trace impurities in heroin by neutron activation analysis. Journal of Radioanalytical and Nuclear Chemistry 2004;262(1):295. [62 heroin samples were analyzed for 15 trace elements by NAA. The authors indicate that the results provide origin information.]


Marijuana:


and principal component analysis. Journal of Natural Products 2004;67:953. [Cultivars could be differentiated by measurement of delta-9-tetrahydrocannabinolic acid and cannabidiolic acid.]

Datwyler SL, Weiblen GD. Genetic variation in hemp and marijuana (Cannabis sativa L.) according to amplified fragment length polymorphisms. Journal of Forensic Sciences 2006;51(2):371. [The results are useful in linking seizures, for source determination, and for differentiating licit and illicit cultivars of cannabis.]


Hsieh HM, Hou RJ, Chen KF, Tsai LC, Liu SW, Liu KL, Linacre A, Lee JC. Establishing the rDNA IGS structure of Cannabis sativa. Journal of Forensic Sciences 2004;49(3):477. [The authors indicate that the technique can be used to identify and classify samples.]


Toonen M, Ribot S, Thissen J. Yield of illicit indoor cannabis cultivation in the Netherlands. Journal of Forensic Sciences 2006;51(5):1050. [Presents a formula for determining a total expected yield of mature female flower buds (sinsimella) from indoor grow operations, regardless of maturity at the time of seizure.]

**Methamphetamine:**

Armellin S, Brenna E, Frigoli S, Fronza G, Fuganti C, Mussida D. Determination of the synthetic origin of methamphetamine samples by 2H NMR spectroscopy. Analytical Chemistry 2006;78(9):3113. [The results suggest that site specific deuterium NMR can assist in classifying methamphetamine as to precursors and synthetic routes.]


Ishibashi H. Analysis of stable isotope ratio of carbon and nitrogen, as a powerful tool to identify smuggling routes of illegal drugs. Kagaku to Kogyo 2004;57(9):964. [A review of the title topic, including discussion of application to methamphetamine and MDMA. Written in Japanese.]

Iwata YT, Inoue H, Kuwayama K, Kanamori T, Tsujikawa K, Miyaguchi H, Kishi T. Forensic application of chiral separation of amphetamine-type stimulants to impurity analysis of seized methamphetamine by capillary electrophoresis. Forensic Science International 2006;161:92. [A highly sulfated gamma-cyclodextrin was used as the chiral selector.]
Kurashima N, Makino Y, Sekita S, Urano Y, Nagano T. Determination of origin of ephedrine used as precursor for illicit methamphetamine by carbon and nitrogen stable isotope ratio analysis. Analytical Chemistry 2004;76(14):4233. [The title technique could easily differentiate between ephedrine of synthetic versus semi synthetic versus biosynthetic origins, and the differences were found to carry through to the methamphetamine produced from those different origins of ephedrine.]


Qi Y, Evans ID, McCluskey A. Australian Federal Police seizures of illicit crystalline methamphetamine ('ice') 1998-2002: Impurity analysis. Forensic Sci Int 2006;164(2-3):201-10. [19 samples seized at Australian POE's were analyzed by methamphetamine impurity profiling techniques; over 30 characteristic impurities were


**Methylenedioxyamphetamines and MDMA:**

Aalberg L, Clark CR, DeRuiter J. Chromatographic and mass spectral studies on isobaric and isomeric substances related to 3,4-methylenedioxymethylamphetamine. Journal of Chromatographic Science 2004;42(9):464. [Reports on the preparation of a number of compounds that are isobaric or isomeric with MDMA, and comments on the similarities and differences in their mass spectra (actual compounds not reported in the abstract).]


Cox M, Klass G. Synthesis by-products from the Wacker oxidation of safrole in methanol using rho-benzoquinone and palladium chloride. Forensic Sci Int 2006;164(2-3):138-47. [Includes analyses of samples from a clandestine laboratory seized in Australia that was employing this synthesis route.]


Kochana J, Wilamowski J, Parczewski A. SPE-TLC profiling of impurities in 1-(3,4-methylenedioxyphenyl)-2-nitropropene, and intermediate in 3,4-methylenedioxymethylamphetamine (MDMA) synthesis. Chromatographia 2004;60(7-8):481. [Appears to be


Palhol F, Lamoureux C, Chabrillat M, Naulet N. N15/N14 Isotopic ratio and statistical analysis: An efficient way of linking seized Ecstasy tablets. Analytica Chimica Acta 2004;510(1):1. [Presents the GC/C/IRMS analyses of MDMA from 106 samples. The results can be used for rapid grouping of similar tablets.]


Teng SF, Wu SC, Liu C, Li JH, Chien CS. Characteristics and trends of 3,4-methylenedioxyamphetamine (MDMA) tablets found in Taiwan from 2002 to February 2005. Forensic Sci Int 2006;161(2-3):202-8. [181 tablets were analyzed by GC/MS. Photographs of the tablet logos are shown.]

van Deursen MM, Lock ER, Poortman-van der Meere AJ. Organic impurity profiling of


**Opium and Opium Alkaoids:**


Ziegler J, DiazChavez M, Kramell R, Ammer C, Kutchan TM. Comparative macroarray

**Multi-Drug and Miscellaneous:**


Bergeron C, Gafner S, Clausen E, Carrier DJ. Comparison of the chemical composition of extracts from Scutellaria lateriflora using accelerated solvent extraction and supercritical fluid extraction versus standard hot water or 70% ethanol extraction. Journal of Agricultural and Food Chemistry 2005;53(8):3076.


Daeid NN, Waddell R. The analytical and chemometric procedures used to profile illicit drug seizures. Talanta 2005;67(2):280.


Leger MN, Ryder AG. Comparison of derivative preprocessing and automated polynomial baseline correction method for classification and quantification of narcotics in


Meier AW, Liu RH. Forensic applications of isotope ratio mass spectrometry. Advances in Forensic Applications of Mass Spectrometry 2004:149 (Chapter 4). [An overview and review. Appears to focus on biological/toxicological forensic applications (not clear in the abstract).]


Visky D, Jimidar I, VanAel W, Vennekens T, Redlich D, DeSmet M. Capillary


VI) Analysis of Non-Controlled Pharmaceuticals, Pseudo-Drugs, Adulterants, Diluents, and Precursors

Issue:

Most "street-level" drugs are "cut" with various adulterants and diluents. Many of these cutting agents are pharmaceutical products or precursors. Others are "carry-through" compounds present in precursors (especially in cold remedy products). Separation and identification of these extraneous materials can be tedious, especially in exhibits which contain many components. In addition, new or unusual adulterants and/or diluents are occasionally identified in drug exhibits, and standard analytical data are required for these substances. Finally, improved methods of analysis, i.e., faster, more discriminatory, less costly, etc., are needed for all cutting agents.

Solution:

Reports providing standard analytical data and/or improved analytical protocols for non-controlled pharmaceuticals, pseudo-drugs, adulterants, diluents, and precursors are generated for the forensic and enforcement communities.

References:

Creatine:


Ephedra, Ephedrine, and/or Pseudoephedrine and Related Compounds:


An OY, Gao XY, Baeyens WRG, Delanghe JR. Determination of ephedrine and related compounds in pharmaceutical preparations by ion chromatography with direct conductivity detection. Biomedical Chromatography 2005;19(4):266.

Avula B, Khan IA. Separation and determination of ephedrine enantiomers and synephrine by high performance capillary electrophoresis in dietary supplements. Chromatographia 2004;59(1-2):71. [For analyses of E. Sinica and various dietary supplement products. The enantiomers of norephedrine, norpseudoephedrine, ephedrine, pseudoephedrine, N-methylephedrine, and N-methylpseudoephedrine were separated.]


Dinc E, Ozdemir A, Aksoy H, Ustundag O, Baleanu D. Chemometric determination of naproxen sodium and pseudoephedrine hydrochloride in tablets by HPLC. Chem Pharm


N-Trimethylsilyl-trifluoroacetamide. Journal of Chromatography B - Analytical Technologies in the Biomedical and Life Sciences 2004;811(2):201. [Includes analysis of ephedrine, pseudoephedrine, cathine, norephedrine, and methylephedrine. Focus is toxicological.]


Wang W, Li C, Li Y, Hu Z, Chen X. Rapid and ultrasensitive determination of ephedrine and pseudoephedrine derivatized with 5-(4,6-dichloro-s-triazin-2-ylamino) fluorescein by...


Phenylpropanolamine:


Other Adulterants/Diluents (including mixtures containing Ephedrine and/or Pseudoephedrine):


Forsdahl G, Gmeiner G. Investigation of the silylation of ephedrines using N-methyl-
N-trimethylsilyl-trifluoroacetamide. Journal of Chromatography B - Analytical Technologies in the Biomedical and Life Sciences 2004;811(2):201. [Includes analysis of ephedrine, pseudoephedrine, cathine, norephedrine, and methylephedrine. Focus is toxicological.]


Haller CA, Duan M, Benowitz NL, Jacob P. Concentrations of ephedra alkaloids and caffeine in commercial dietary supplements. Journal of Analytical Toxicology 2004;28:145. [Presents a novel LC MS/MS technique for performing the title analysis, 35 products were analyzed.]


Lapitskaya MA, Zatonsky GV, Pivnitsky KK. Enantiomeric NMR analysis of chiral epoxides as addition compounds with d-ephedrine. Mendeleev Communications 2005;(5):175.


**Miscellaneous:**


Cheng YQ, Fan LY, Chen HL, Chen XG, Hu ZD. Method for on-line derivatization and separation of aspartic acid enantiomer in pharmaceuticals application by the coupling of flow injection with micellar electrokinetic chromatography. Journal of Chromatography


analyses.]


Himmelsbach M, Buchberger W, Klampfl CW. Determination of antidepressants in surface and waste water samples by capillary electrophoresis with electrospray ionization mass spectrometric detection after preconcentration using off-line solid-phase extraction. Electrophoresis 2006;27(5-6):1220.


Majumdar TK. Commonly encountered analytical problems and their solutions in liquid chromatography/tandem mass spectrometry (LC/MS/MS) methods used in drug development. Identification and Quantification of Drugs, Metabolites and Metabolizing Enzymes by LC - MS; Progress in Pharmaceutical and Biomedical Analysis 2005;6):35.


Song GX, Deng CH, Wu D, Hu YM. Headspace solid-phase microextraction-gas chromatographic-mass spectrometric analysis of the essential oils of two traditional


VII) New and/or Improved Instrumental Techniques

Issue:
Forensic Chemists must maintain familiarity with updates in current instrumental techniques and become versant in new, improved methods of analysis.

Solution:
Improved/existing and new technologies are reviewed and applied to both routine and specialized analyses of drugs. In cases where improved performance is observed, case reports are generated for the forensic community.

References:

Capillary Electrophoresis (and Related Techniques, including Tandem Techniques):


Ding Y, Garcia CD. Application of microchip-CE electrophoresis to follow the degradation of phenolic acids by aquatic plants. Electrophoresis 2006;27(24):5119-27.


Liu Z, Pawliszyn J. Microdialysis hollow fiber as a macromolecule trap for on-line coupling of solid phase microextraction and capillary electrophoresis. Analyst


Microgram Journal 2016, Volume 13; Numbers 1-4
abstract).


Szoko E, Tabi T, Borbas T, Dalmadi B, Tihanyi K, Magyar K. Assessment of the


**Extraction Techniques:**

Bergeron C, Gafner S, Clausen E, Carrier DJ. Comparison of the chemical composition of extracts from Scutellaria lateriflora using accelerated solvent extraction and supercritical fluid extraction versus standard hot water or 70% ethanol extraction. Journal of Agricultural and Food Chemistry 2005;53(8):3076.


**Gas Chromatography (and Tandem GC Techniques):**


Dimandja J-MD. GC x GC. Analytical Chemistry 2004;76(9):167A. [An overview and review of two-dimensional GC techniques.]

Hodjmohammadi MR, Ebrahimi P, Pourmorad F. Quantitative structure-retention relationships (QSRR) of some CNS agents studied on DB-5 and DB-17 phases in gas chromatography. QSAR & Combinatorial Science 2004;23(5):295.


Song SM, Marriott P, Kotsos A, Drummer OH, Wynne P. Comprehensive two dimensional gas chromatography with time of flight mass spectrometry (GC x GC TOFMS) for drug screening and confirmation. Forensic Science International 2004;143(2-3):87. [78 drugs of interest were analyzed, some forensic samples were also analyzed satisfactorily.]

Song SM, Marriott P, Wynne P. Comprehensive two-dimensional gas chromatography - quadrupole mass spectrometric analysis of drugs. Journal of Chromatography A 2004;1058(1-2):223. [77 underivatized drug standards (not specified in the abstract) were analyzed by the title technique. Appears to be related to a similarly titled article published in Forensic Science International 2004;143(2-3):87 (using TOF-MS).]


**High-Performance Liquid Chromatography (and tandem HPLC techniques):**

Ali Z, Poole C. Insights into the retention mechanism of neutral organic compounds on

Balogh MP. DESI, IMS, and resurgent challenges to HPLC-MS. LC-GC North America 2006;24(1):46. [An overview.]

Barri T, Jonsson JA. Supported liquid membrane work-up of blood plasma samples coupled on-line to liquid chromatographic determination of basic antidepressant drugs. Chromatographia 2004;59(3-4):161.


Esteve-Romero J, Carda-Broch S, Gil-Agusti M, Capella-Peiro ME, Bose D. Micellar liquid chromatography for the determination of drug materials in pharmaceutical preparations and biological samples. TRAC - Trends In Analytical Chemistry
2005;24(2):75.


Lambert W. Pitfalls in LC-MS(-MS) analysis. Bulletin TIAFT 2004;34(2):59. [Discusses the title subject. Includes numerous references.]

Lambert W. Pitfalls in LC-MS(-MS) Analysis. Toxichem und Krimtech 2004;71(2):64. [Language not specified in the abstract (may be in German). A review. Appears to be a re-publication of the article by the same author and title in Bulletin TIAFT 2004;28(6):439.]


Thompson R. A practical guide to HPLC enantioseparations for pharmaceutical compounds. Journal of Liquid Chromatography & Related Technologies


Zhou LZ. Applications of LC/MS in pharmaceutical analysis. Separation Science and Technology 2005;6,499.

**Inductively Coupled Plasma- Mass Spectrometry (ICP-MS, Also ICP-OES):**


Sarin RK, Srivastava S, Srivastava AK, Anil G, Reddy MRP. Multielement
determination in gum opium by microwave digestion and inductively coupled plasma optical emission spectroscopy. Chemical Papers 2004;58(2):101. [Presents the analysis of Indian gum opium by the title technique (13 elements found in quantifiable levels).]


**Infrared and Raman Spectroscopy:**


Bell SEJ, Sirimuthu NMS. Rapid, quantitative analysis of ppm/ppb nicotine using surface-enhanced Raman scattering from polymer-encapsulated Ag nanoparticles (Gel-colls). Analyst 2004;129(11):1032.


Causin V, Marega C, Carresi P, Schiavone S, Marigo A. A quantitative differentiation method for plastic bags by infrared spectroscopy, thickness measurement, and differential scanning calorimetry for tracing the source of illegal drugs. Forensic Science International 2006;164(2-3):148. [50 bags of types typically used for drug packaging were analyzed. The results indicate that even mass-produced bags have a large degree of
variability, and can be differentiated and/or linked.


**Ion Spectroscopy:**


**Mass Spectrometry:**


Pavlic M, Libiseller K, Oberacher H. Combined use of ESI-QqTOF-MS and ESI-QqTOF-MS/MS with mass-spectral library search for qualitative analysis of drugs. Analytical and Bioanalytical Chemistry 2006;386(1):69. [319 drugs (therapeutic and illicit) were analyzed. The resulting spectral library was successfully applied to the characterization of 39 forensic casework samples.]


Rubakhin SS, Jurchen JC, Monroe EB, Sweedler JV. Imaging mass spectrometry:


Shao X, Wang G, Wang S, Su Q. Extraction of mass spectra and chromatographic profiles from overlapping GC/MS signals with background. Analytical Chemistry 2004;76(17):5143. [The authors indicate that the presented methodology is better than the SIMPLISMA technique.]


**Microchip Technology:**


**Nuclear Magnetic Resonance Spectroscopy:**


Osokin DY, Khusnutdinov RR. Two-frequency composite pulses in NQR. Applied Magnetic Resonance 2006;30(1):7. [Use of the title technique for detection of narcotics is specifically mentioned in the abstract (NFI).]

**Solid Phase Micro-Extraction (Headspace Techniques and Solvent Analysis):**


Rearden P, Harrington PB. Rapid screening of precursor and degradation products of chemical warfare agents in soil by solid-phase microextraction ion mobility spectrometry


**Thin Layer Chromatography:**


**X-Ray based Techniques:**


**Miscellaneous:**


Gartsev NA, Semeikin NP, Sharshin YA, Pomozov VV, Nedorezov AV, Nikiforov AA. Detector for detection of explosives and drugs. RU 2234695 C1 20 Aug 2004. CLASS: ICM: G01N024 00. APPLICATION: RU 2003 106186 6 Mar 2003. [Appears to be based on nuclear quadrupole resonance detection. Drugs not specified. This patent is written in Russian.]

Henry KD, Lovell JS. Stroboscopic system and method for detecting substances, such as explosives and/or drugs, using, in part, short bursts of energy light from a relatively low energy strobe. (Patent) Chemical Abstracts 2006;145:350077u.


Srinivas NR. Simultaneous chiral analyses of multiple analytes: Case studies, implications and method development considerations. Biomedical Chromatography 2004;18(10):759. [A review, includes some illustrative case studies.]


VIII) Portable Detection and Analytical Instrumentation

Issue:
"Free Trade" agreements and the easing of formally restrictive national and international borders have resulted in dramatic increases in cargo transshipments and personal travel, thereby complicating drug inspection and interdiction efforts at POEs. Discovery and confirmational analysis of suspected drugs in cargo or on individuals is severely hampered by the lack of on-site detection and/or analytical equipment.

Solution:
Development of portable and highly sensitive detectors for drug detection and analyses allows law enforcement personnel and/or forensic chemists to perform screening type analyses on-site. In those cases where new methodologies have proven effective, case reports are generated for the forensic and enforcement communities.

References:


Chen Y, Pawliszyn J. Solid-phase microextraction field sampler. Analytical Chemistry


IX) Miscellaneous

References:

Analytical Artifacts:


Chemometrics:


Gosav S, Praisler M, Dorohoi DO, Popa G. Structure-activity correlations for illicit amphetamines using ANN and constitutional descriptors. Talanta 2006;70(5):922. [Compounds not specified in the abstract. "ANN" is an acronym for an artificial neural network; the "constitutional descriptors" were not specified in the abstract. The primary database consisted of GC-FTIR data for a large number of drugs of abuse and related compounds.]


Hu Y, Liang YZ, Li BY, Li XN, Du YP. Multicomponent spectral correlative


Leger MN, Ryder AG. Comparison of derivative preprocessing and automated polynomial baseline correction method for classification and quantification of narcotics in solid mixtures. Appl Spectrosc 2006;60(2):182-93.


**Cocaine:**

Bowen RAR, George DT, Hortin GL. False-negative result for cocaine metabolites on a


**Counterfeit Drugs:**


deKieffer DE. The Internet and the globalization of counterfeit drugs. Journal of Pharmacy Practice 2006;19:171-177.


Mukhopadhyay R. The hunt for counterfeit medicine. Drugs manufactured by counterfeiters are infiltrating markets worldwide. Investigators are harnessing a variety of analytical techniques to catch as many of the fakes as they can. Anal Chem 2007;79(7):2622-7.


**Dragon's Blood:**


**Drugs on Currency:**


Frederick KA, Pertaub R, Ski Kam NW. Identification of individual drug crystals on paper currency using Raman microspectroscopy. Spectroscopy Letters 2004;37(3):301. [Presents and discusses the title study, using simulated drugs (isoxsuprine and norephedrine) and two common excipients (benzocaine and lidocaine). Fluorescence issues with U.S. currency are discussed.]


**Heroin:**


**Legal Issues:**


**Enantiomer Resolution:**


**Methamphetamine:**


**Qualitative Tests:**


Zhang S. Kit for combined detection of drugs, its preparation method and blocking agents used for the same. (Patent) Chemical Abstracts 2006;144:144626y.

**Quality Assurance:**


Wille SMR, Lambert WEE. Phenmetrazine or ephedrine? - Fooled by library search. Journal of Chromatography A 2004;1045(1-2):259. [Ephedrine reacted with formaldehyde in solvents to give a compound with a mass spectrum that is similar to phenmetrazine (compound not identified in the abstract).]


**Sampling Plans:**


Horrocks M. Sub-sampling and preparing forensic samples for pollen analysis. Journal of Forensic Sciences 2004;49(5):1024. [The applications include a brief discussion of illicit drugs.]


**Other:**


Kucht S, Gross J, Hussein Y, Grothe T, Keller U, Basar S, Konig WA, Steiner U, Leistner E. Elimination of ergoline alkaloids following treatment of Ipomoea asarifolia


