The 2004 "Research on Drug Evidence" Report

[From the 14th ICPO / INTERPOL Forensic Science Symposium]

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ABSTRACT: A reprint of the 2004 "Research on Drug Evidence" Report (a review) is provided.

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

Important Information:

Presented at the 14th ICPO / INTERPOL Forensic Science Symposium, Lyon, France, October 19 - 22, 2004.

For pertinent background, see: Klein RFX. ICPO / INTERPOL Forensic Science Symposia, 1995 - 2016. "Research on Drug Evidence". Prefacing Remarks (and a Request for Information). Microgram Journal 2016;13(1-4):1-3.

Citations in this report from the *Journal of the Clandestine Laboratory Investigating Chemists Association* and *Microgram* were (and remain) Law Enforcement Restricted. Microgram was split into *Microgram Bulletin* and *Microgram Journal* in 2002 and 2003, respectively; except for the 2002 Bulletins, both the Bulletin and Journal were (and are) unclassified.

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 original document is not retained in this reprint, and some minor reformatting was done to eliminate deadspace.

Research On Drug Evidence

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Notes:

1. All categories are subdivided by topic or category, then alphabetically by the first author's 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 references are law enforcement restricted, and not available to the general public: *Microgram* and *Microgram Bulletin* prior to 2003, and 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:

1) Brettell TA, Rudin N, Saferstein R. Forensic science. Analytical Chemistry 2003;75(12):2877. [A two year review of the forensic science literature.]

2) Christian DR Jr. Analysis of controlled substances. Forensic Science 2003:375. [A review of the title topic (forensic emphasis). This is a CRC Press publication.]

3) Cole MD, Linacre AMT. The identification of controlled plant drugs using phytochemistry and DNA. Current Topics in Phytochemistry 2002;5:129. [A minor review of the title topic, focusing on marijuana, catha edulis, papaver somniferum, and erythroxylum.]

4) Dal Cason TA, Franzosa ES. Occurrences and forms of the hallucinogens. Hallucinogens 2003:37. [A review, including LSD and its analogs, indoalkylamines, hallucinogenic phenethylamines, PCP and its analogs, ketamine, and beta-carbolines.]

5) Hugel J, Meyers J, Lankin D. Analysis of the hallucinogens. Hallucinogens 2003:191. [A review of the forensic analysis of hallucinogens.]

6) Klein RFX, Hays PA. Detection and analysis of drugs of forensic interest, 1992 - 2001;

A literature review. Microgram Journal 2003;1(1-2):55. [A ten year review of the forensic science literature.]

Scientific Working Group for Forensic Analysis of Illicit Drugs:

7) Bono JP. Report of the Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) Conference. Microgram Journal 2003;1(3-4):208. [A summary of the Conference's findings and recommendations.]

8) Bono JP, Janovsky TJ. Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) - Update. Proceedings of the American Academy of Forensic Sciences 2004;10:67. [An update of the accomplishments and objectives of the SWGDRUG.]

9) Janovsky TJ, Bono JP. Scientific Working Group for the Analysis of Forensic Drug Samples (SWGDRUG) - Update 2002. Proceedings of the American Academy of Forensic Sciences 2002;8:30. [An update of the accomplishments and objectives of the SWGDRUG.]

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

10) Brown H, Kirkbride KP, Pigou PE, Walker GS. New developments in SPME, Part 1: The use of vapor-phase deprotonation and on-fiber derivatization with alkylchloroformates in the analysis of preparations containing amphetamines. Journal of Forensic Sciences 2003;48(6):1231. [Presents a method for conversion of solid drug salts to their free bases, capture via SPME, and analysis by GC/MS. The technique can be used for noninvasive recovery from consumer items such as banknotes and garments. Use of on-fiber derivatization with alkylchloroformates improves chromatography and also allows for enantiomer determinations.]

11) Chan KB, Chong YK, Nazarudin M. The identification of N,N-dimethylamphetamine (DMA) in an exhibit in Malaysia. Microgram Journal 2003;1(3-4):162. [Presents the title analysis, using color tests, GC/MS, FTIR, HPLC, melting point, and optical rotation.]

12) Faulds K, Smith WE, Graham D, Lacey RJ. Assessment of silver and gold substrates for the detection of amphetamine sulfate by surface enhanced Raman Scattering (SERS). Analyst 2002;127(2):282.

13) Herraez-Hernandez R, Campins-Falco P, Verdu-Andres J. Strategies for the enantiomeric determination of amphetamine and related compounds by liquid chromatography. Journal of Biochemical and Biophysical Methods 2002;54(1-3):147. [Presents a review of recent advances in the title field, with an emphasis on biological samples.]

14) Liau AS, Liu JT, Lin LC, Chiu YC, Shu YR, Tsai CC, Lin CH. Optimisation [sic] of a simple method for the chiral separation of methylamphetamine and related compounds in clandestine tablets and urine samples by beta-cyclodextrin modified capillary electrophoresis: A complementary method to GC-MS. Forensic Science International 2003;134(1):17. [Compounds include methamphetamine, methcathinone, ephedrine, and pseudoephedrine. The focus is toxicological.]

15) Lua AC, Chou TY. Preparation of immunoaffinity columns for direct enantiomeric separation of amphetamine and/or methamphetamine. Journal of Chromatography A 2002;967(2):191. [For direct enantiomeric determination of amphetamine and methamphetamine in urine.]

16) Matsushima K, Nagai T, Nihei H, Kikuchi F, Tokudome S. Analysis of a new type of tablet containing l-(-)-methylamphetamine. Japanese Journal of Science and Technology for Identification. 2003;8(1):99. [Presents the analysis of the referenced tablet (which also included ketamine and caffeine).]

17) Wang S-M, Liu RH. Solid-phase microextraction based approach for enantiomeric analysis of amphetamines. Proceedings of the American Academy of Forensic Sciences 2004;10:72. [Diastereomers were created via derivatization with S-(-)-N-trifluoroacetyl-prolyl chloride, followed by isolation with SPME, followed by analysis.]

para-Substituted Amphetamines:

18) Dal Cason TA. A re-examination of the mono-methoxy positional ring isomers of amphetamine, methamphetamine, and phenyl-2-propanone. Forensic Science International 2001;119(2):168.

19) Mortier KA, Dams R, Lambert WE, De Letter EA, Van Calenbergh S, De Leenheer AP. Determination of para-methoxyamphetamine and other amphetamine-related designer drugs by liquid chromatography/sonic spray ionization mass spectrometry. Rapid Communications in Mass Spectrometry 2002 16(9):865. [For analysis of tablets, powders, or aqueous solutions.]

Barbiturates:

20) Bartzatt R. Determination of barbituric acid, utilizing a rapid and simple colorimetric assay. Journal of Pharmaceutical and Biomedical Analysis 2002;29(5):909. [Presents three assay methods, which can be utilized on either aqueous or solid samples.]

21) Chang W-T, Smith J, Liu RH. Isotopic analogs as internal standards for quantitative GC/MS analysis - Molecular abundance and retention time differences as interference factors. Journal of Forensic Sciences 2002;47(4):873. [Isotopic analogues of five barbiturates were evaluated as internal standards for GC/MS analyses.]

22) Forgacs E, Cserhati T, Miksik I, Echardt A, Deyl Z. Simultaneous effect of organic modifier and physicochemical parameters of barbiturates on their retention on a narrow-bore PGC column. Journal of Chromatography B - Analytical Technologies in the Biomedical and Life Sciences 2004;800(1-2):259. [Presents the analysis of 22 barbiturates on a narrow-bore porous graphitized carbon column using water-dioxane mobile phases.]

23) Jones, JJ, Kidwell H, Games DE. Application of atmospheric pressure chemical ionisation [sic] mass spectrometry in the analysis of barbiturates by high speed analytical countercurrent chromatography. Rapid Communications in Mass Spectrometry 2003;17(14):1565. [Presents the analysis of four barbiturates (barbital, allobarbital, phenobarbital, and butalbital) using the title technique.]

24) Kepczynska E, Bojarski J, Pyka A. Lipophilicity of barbiturates determined by TLC. Journal of Liquid Chromatography and Related Technologies 2003;26(19):3277. [Thirteen 5,5-disubstituted derivatives of barbituric acid were analyzed by RP-TLC.]

Benzodiazepines:

25) Aebi B, Sturny-Jungo R, Bernhard W, Blanke R, Hirsch R. Quantitation using GC-TOF-MS: Example of bromazepam. Forensic Science International 2002;128(1-2):84. [Various methods are used to validate the use of GC-TOF-MS for analysis of bromazepam; diazepam and nordazepam were also studied, but to a lesser extent.]

26) Bakavoli M, Kaykhaii M. Quantitative determination of diazepam, nitrazepam and flunitrazepam in tablets using thin-layer chromatography - densitometry technique. Journal of Pharmaceutical and Biomedical Analysis 2003;31(6):1185. [Also includes

and contrasts HPLC analyses; UV (254 nm) detection was used for both techniques.]

27) Benson A, Rose S, Hsu Y, Furton KG, Sabucedo A. LC/MS analysis of flunitrazepam (Rohypnol) solid dosage tablets. Proceedings of the American Academy of Forensic Sciences 2004;10:78.

28) Cahours X, Cherkaoui S, Rozing G, Veuthey JL. Microemulsion electrokinetic chromatography versus capillary electrochromatography-UV-mass spectrometry for the analysis of flunitrazepam and its major metabolites. Electrophoresis 2002;23(14):2320. [Flunitrazepam and its three major metabolites (in biological fluids) were separated by the title technique.]

29) Ferreyra CF, Ortiz CS. Simultaneous spectrophotometric determination of phenylpropanolamine HCl, caffeine and diazepam in tablets. Journal of Pharmaceutical and Biomedical Analysis 2002;29(5):811. [UV spectrophotometry and LC methods were used.]

30) Kamande MW, Kapnissi CP, Zhu XF, Akbay C, Warner IM. Open-tubular capillary electrochromatography using a polymeric surfactant coating. Electrophoresis 2003;24(6):945. [The title technique was applied to the analysis of benzodiazepines (not specified in the abstract).]

31) Pirnay S, Ricordel I, Libong D, Bouchonnet S. Sensitive method for the detection of 22 benzodiazepines by gas chromatography - ion trap tandem mass spectrometry. Journal of ChromatographyA 2002;954:235. [The title technique method was applied to biological samples.]

32) Saelzer R, Gody G, Vega M, De Diego M, Godoy R, Rios G. Instrumental planar chromatographic determination of benzodiazepines: Comparison with liquid chromatography and gas chromatography. JAOAC International 2001;84(4):1287.

33) Suzuki Y, Arakawa H, Maeda M. The capillary electrophoresis separation of benzodiazepine drugs using dextran sulfate and SDS as running buffer. Biomedical Chromatography 2004;18(3):150. [Presents the EKC analysis of 10 benzodiazepines (not specified in abstract). The authors claim that the presented method may also be used for many other pharmaceuticals.]

<u>Dimethoxyphenethylamines</u>:

34) Cole MD, Lea C, Oxley N. 4-Bromo-2,5-dimethoxyphenethylamine (2C-B): A review of the public domain literature. Science Justice 2002;42(4):223. [An overview of the title compound, including a minor review of the available literature.]

35) Curtis B, Kemp P, Harty L, Choi C, Christensen D. Postmortem identification and quantitation of 2,5-dimethoxy-4-n-propylthiophenethylamine using GC-MSD and GC-NPD. Journal of Analytical Toxicology 2003;27(7):493. [Primary focus is analysis of biological fluids and tissue samples; however, includes a small scale mass spectra (from GC/MS) of the title compound (i.e., 2C-T-7).]

Chlordiazepoxide:

36) EHefnawey GB, ElHallag IS, Ghoneim EM, Ghoneim MM. Voltammetric behavior and quantification of the sedative-hypnotic drug chlordiazepoxide in bulk form, pharmaceutical formulation, and human serum at a mercury electrode. Journal of Pharmaceutical and Biomedical Analysis 2004;34(1):75. [Includes comparisons against existing methods.]

Clenbuterol:

37) Chankvetadze B, Lomsadze K, Bergenthal D, Breitkreutz J, Bergander K, Blaschke G. Mechanistic study on the opposite migration order of clenbuterol enantiomers in capillary electrophoresis with beta-cyclodextrin and single isomer heptakis(2,3-diacetyl-6-sulfo)-beta-cyclodextrin. Electrophoresis 2001;22(15):3178.

38) Garcia-Ruiz C, Marina ML. Fast enantiomeric separation of basic drugs by electrokinetic chromatography. Application to the quantitation of terbutaline in a pharmaceutical preparation. Electrophoresis 2001;22(15):3191. [Includes clenbuterol.]

39) Ozkan Y, Ozkan SA, AboulEnein HY. Determination of clenbuterol HCl in human serum, pharmaceuticals, and in drug dissolution studies by RP-HPLC. Journal of Liquid Chromatography and Related Technologies 2001;24(5):679.

Cocaine:

40) Cabovska B, Norman AB, Stalcup AM. Separation of cocaine stereoisomers by capillary electrophoresis using sulfated cyclodextrins. Analytical and Bioanalytical Chemistry 2003;376(1):134.

41) Koulis CV, Reffner JA, Bibby AM. Comparison of transmission and internal reflection spectra of cocaine. Journal of Forensic Science 2001;46(4):822. [Study is on cocaine hydrochloride; includes cautionary notes on the use of ATR.]

42) Rofael HZ, AbdelRahman MS. Development and validation of a high-performance liquid chromatography method for the determination of cocaine, its metabolites and ketamine. Journal of Applied Toxicology 2002;22(2):123.

43) Swiatko J, De Forest PR, Zedeck MS. Further studies on spot tests and microcrystal tests for identification of cocaine. Journal of Forensic Sciences 2003;48(3):581. [Presents a study of the Wagner, Marquis, and cobalt thiocyanate spot tests, and the gold chloride and platinic chloride microcrystal tests, for the identification of cocaine.]

Ergot Alkaloids (see also LSD):

44) Stahl M, Jakob A, von Brocke A, Nicholson G, Bayer R. Comparison of different setups for one- and two-dimensional capillary high-performance liquid chromatography and pressurized capillary electrochromatography coupled on-line with mass spectrometry. Electrophoresis 2002;23(17):2949. [Presents a comparison of different separation methods (HPLC, capillary HPLC, and pressurized capillary electrochromatography (pCEC)) coupled on-line with mass spectrometry (MS)) for the separation of a crude extract of ergot fungus (secalis cornuti).]

Fentanyl(s):

45) DeBoer D, Goemans WPJ, Ghezavat VR, vanOoijen RD, Maes RAA. Seizure of illicitly produced para-fluorofentanyl: Quantitative analysis of the content of capsules and tablets. Journal of Pharmaceutical and Biomedical Analysis 2003;31(3):557. [Presents a GC/MS methodology for the title analysis; HPLC/UV was also used to quantify caffeine being used as an adulterant. The samples derived from an illicit laboratory in the Netherlands.]

46) Jimeno ML, Alkorta I, Cano C, Jagerovic N, Goya P, Elguero J, FocesFoces C. Fentanyl and its analogue N-(1-phenylpyrazol-3-yl)-N-[2-phenylethyl-4-piperidyl]propanamide: H-1 and C-13 NMR spectroscopy, X-ray crystallography, and theoretical calculations. Chemical and Pharmaceutical Bulletin 2003;51(8):929. [The oxalate salts and free bases of the title compounds were analyzed by the title techniques.]

47) Van Nimmen NFJ, Veulemans HAF. Development and validation of a highly sensitive

gas chromatographic - mass spectrometric screening method for the simultaneous determination of nanogram levels of fentanyl, sufentanil, and alfentanil in air and surface contamination wipes. Journal of Chromatography A 2004;1035(2):249. [Focus is on sampling for industrial occupational exposure. The technique uses SIM.]

***Flos daturae*:**

48) Ye NS, Zhu RH, Gu XX, Zou H. Determination of scopolamine, atropine and anisodamine in Flos daturae by capillary electrophoresis. Biomedical Chromatography 2001;15(8):509.

Fluoxetine (Prozac):

49) Olsen BA, Borer MW, Perry FM, Forbes RA. Screening for counterfeit drugs using near-infrared spectroscopy. Pharmaceutical Technology North America 2002;26(6):62. [Uses NIR to screen and differentiate Prozac vs. many generic formulations.]

Heroin:

50) Dongre VG, Kamble VW. HPTLC detection and identification of heroin (diacetyl-morphine) in forensic samples. Part III. Journal of Planar Chromatography - Modern TLC 2003;16(6):458. [Presents a new spray reagent for detection of heroin and similar opium alkaloids after TLC elution.]

51) Fitsev IM, Budnikov GK, Blokhin VK, Teslenko PG. Gas chromatographic determination of diacetylmorphine with mass spectrometric detection. Journal of Analytical Chemistry (English translation of Zhurnal Analiticheskoi Khimii) 2003;47(9-12):423. [Appears to be a GC/MS method for analysis of heroin in fluids (not clear in abstract).]

52) Kulikowska J, Celinski R, Soja A, Sybirska H. Investigations on the quality of home-made poppy straw products ("Compote") at the forensic medicine department in Katowice. Proceedings, 39th Annual TIAFT Meeting, Prague, 2001. [Illicit production of morphine and heroin in Poland (from poppy straw) is reviewed, and the techniques used for analysis of these products are discussed.]

53) Lurie IS, Hays PA, Garcia AE, Panicker S. Use of dynamically coated capillaries for the determination of heroin, basic impurities, and adulterants with capillary electrophoresis. Journal of Chromatography A 2004;1034(1-2):227.

54) Macchia M, Manetto G, Mori C, Papi C, Di Pietro N, Salotti V, Bortolotti F, Tagliarro F. Use of beta-cyclodextrin in the capillary zone electrophoretic separation of the components of clandestine heroin preparations. Journal of Chromatography A 2001;924(1):499.

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

55) Alston WC, Ng K. Rapid colorimetric screening test for gamma-hydroxybutyric acid (Liquid X) in human urine. Forensic Science International 2002;126(2):114. [Based on the ferric hydroxamate test for ester detection; takes 5 minutes and has a detection limit 0.1 mg/mL for 1 mL samples.]

56) Bishop SC, McCord BR, Svec F. Analysis of GHB and its analogs by capillary electrochromatography. Proceedings of the American Academy of Forensic Sciences 2002;8:268. [Includes analysis of GHB, GBL. BD, and gamma-aminobutyric acid (GABA).]

57) Bravo DT, Harris DO, Parsons SM. Reliable, sensitive, rapid, and quantitative enzyme-based assay for gamma-hydroxybutyric acid (GHB). Journal of Forensic Sciences 2004;49(2):379. [Several assays are presented for detection of GHB in beverages and urine.]

58) Chappell JS. The non-equilibrium aqueous solution chemistry of gamma-hydroxybutyric acid. Journal of the Clandestine Laboratory Investigating Chemists Association 2002;12(4):20. [Presents a study of the chemistry of GHB in aqueous solutions.]

59) Chappell JS, Meyn AW, Ngim KK. The extraction and infrared identification of gamma-hydroxybutyric acid (GHB) from aqueous solutions. Journal of Forensic Sciences 2004;49(1):52. [Presents a liquid-liquid extraction technique for isolating GHB free acid, with analysis by IR.]

60) Chew SL, Meyers JA. Identification and quantitation of gamma-hydroxybutyrate (NaGHB) by nuclear magnetic resonance spectroscopy. Journal of Forensic Sciences 2003;48(2):292. [Presents an NMR technique for identification and quantitation of GHB; the identification of GBL by NMR is also presented.]

61) Ciolino LA, Mesmer MZ, Satzger RD, Machal AC, McCauley HA, Mohrhaus AS. The chemical interconversion of GHB and GBL: Forensic issues and implications. Journal of

Forensic Sciences 2001;46(6):1315.

62) Dahlen J, Vriesman T. Simultaneous analysis of gamma-hydroxybutyric acid, gamma-butyrolactone, and 1,4-butanediol by micellar electrokinetic chromatography. Forensic Science International 2002;125(2-3):113.

63) DeFrancesco JV. An NMR study of the stability of gamma-butyrolactone (GBL) in water. Proceedings of the American Academy of Forensic Sciences 2003;9:32. [Presents a study of the conversion of GBL to GHB over time, starting with different concentrations of GBL.]

64) Duer WC, Byers KL, Martin JV. Application of a convenient extraction procedure to analyze gamma-hydroxybutyric acid in fatalities involving gamma-hydroxybutyric acid, gamma-butyrolactone, and 1,4-butanediol. Journal of Analytical Toxicology 2001;25(7):576.

65) Garcia AD, Catterton AJ. 1,4-Butanediol (BD) - Forensic profile. Microgram Journal 2003;1(1-2):44.

66) Meyers JE, Garcia AD, Almirall JR. The analysis of gamma-hydroxybutyric acid (GHB) and gamma-butyrolactone (GBL) in forensic samples using GC/MS and H1-NMR. Proceedings of the American Academy of Forensic Sciences 2003;9:30. [Presents the referenced analyses, and also discusses the interconversion between the two substrates. SPME was utilized to recover the substrates for analysis.]

67) Meyers JE, Almirall JR. The analysis of gamma-hydroxybutyric acid (GHB) and gamma-butyrolactone (GBL) in forensic samples using gas chromatography/mass spectrometry (GC/MS) and proton nuclear magnetic resonance (H1-NMR). Proceedings of the American Academy of Forensic Sciences 2004;10:57. [Further investigates the interconversion between GHB and GBL, and presents a procedure for avoiding interconversion prior to analysis.]

68) Negrusz A, Cooper FJ, LeBeau MA, Marinetti LJ, Borgen LA, Zvosek DL, Smith SW. GHB: Old substance, new problem. Proceedings of the American Academy of Forensic Sciences 2002;8:10. [A workshop presenting a comprehensive overview of the title compound.]

69) Parsons SM, Harris DO, Bravo DT. Methods, compositions and apparatuses for detection of gamma-hydroxybutyric acid (GHB). U.S. Pat. Appl. Publ. US 2003 175,846 (Cl.

435-25; C12Q1/26), 18 Sep 2003, Appl. 98,811, 14 Mar 2002. [Presents a method for detecting GHB using a biochemical reaction.]

70) Smith JV. Method for detection of 4-hydroxybutyric acid and its precursor(s) in fluids. U.S. US 6,617,123 (Cl. 435-19; C12Q1/44), 9 Sep 2003, Appl 607,026, 29 Jun 2000. [Appears to be a detection method for adulterated beverages (not biological fluids).]

71) Sabucedo AJ, Furton KG. Extractionless GC/MS analysis of gamma-hydroxybutyrate and gamma-butyrolactone with trifluoroacetic anhydride and heptafluoro-1-butanol from aqueous samples. Proceedings of the American Academy of Forensic Sciences 2004;10:109. [GHB can be derivatized directly in water solutions, without organic solvent extraction needed. GABA, diethylene glycol, BD, and GBL were analyzed under the same conditions (GBL gave a small response from conversion to GHB).]

72) Tanaka E, Terada M, Shinozuka T, Honda K. gamma-Hydroxybutyric acid (GHB); its pharmacology and toxicology. Japanese Journal of Forensic Toxicology 2003;21(3):210. [An overview and brief review.]

73) Vose J, Tighe T, Schwartz M, Buel E. Detection of gamma-butyrolactone (GBL) as a natural component in wine. Journal of Forensic Sciences 2001;46(5):1164.

74) Witkowski MR, Ciolino LA, DeFrancesco JV. GHB free acid: More on issues of interconversion with isolation and spectroscopic characterization of forensic analysis. Proceedings of the American Academy of Forensic Sciences 2003;9:30. [A forensic profile of the free acid (versus the more commonly encountered base form) is presented and discussed.]

75) Witkowski MR, Ciolino LA. Infrared (IR) spectroscopic identification of GHB free acid, GHB salts, and GBL. Proceedings of the American Academy of Forensic Sciences 2003;9:31. [Includes an in-depth discussion.]

Ketamine:

76) Standifer SR, Kercheval JC. Special K and the K-hole. Analysis of ketamine. Mid-Atlantic Association of Forensic Scientists Newsletter 2001;29(2):6.

Khat:

77) Kite GC, Ismail M, Simmonds MSJ, Houghton PJ. Use of doubly protonated molecules

in the analysis of cathedulins in crude extracts of khat (Catha edulis) by liquid chromatography/serial mass spectrometry. Rapid Communications in Mass Spectrometry 2003;17(14):1553. [Analysis of fresh khat by LC/MS revealed 62 cathedulins.]

LSD:

78) Fang C, Liu JT, Lin CH. Optimization of the separation of lysergic acid diethylamide in urine by a sweeping technique using micellar electrokinetic chromatography. Journal of Chromatography B - Analytical Technologies in the Biomedical and Life Sciences 2002;775(1):37. [Presents the separation and analysis of LSD, iso-LSD, and LAMPA by capillary electrophoresis - fluorescence spectroscopy using sodium dodecyl sulfate (SDS) as an anionic surfactant.]

79) Fang C, Liu JT, Lin CH. On-line identification of lysergic acid diethylamide (LSD) in tablets using a combination of a sweeping technique and micellar electrokinetic chromatography/77 K fluorescence spectroscopy. Electrophoresis 2003;24(6):1025. [Presents and contrasts the title analysis with standard GC/MS methods.]

80) Libong D, Bouchonnet S. Collision-induced dissociations of trimethylsilylated lysergic acid diethylamide (LSD) in ion trap multiple stage mass spectrometry. International Journal of Mass Spectrometry 2002;219(3):615. [Presents a highly sensitive GC/MS-MS method for detection of LSD.]

Marijuana and Related Cannabinoids:

81) Alghanim HJ, Almirall JR. Development of microsatellite markers in Cannabis sativa for DNA typing and genetic relatedness analyses. Analytical and Bioanalytical Chemistry 2003;376(8):1225.

82) Coyle HM, Palmbach T, Juliano N, Ladd C, Lee HC. An overview of DNA methods for the identification and individualization of marijuana. Microgram Journal 2003;1(3-4):196. [Presents the title overview and review. Note that this article is a reprint from the Croatian Medical Journal 2003;44(3):315.]

83) Fucci N. Growing cannabis with naphthalene in Rome. Forensic Science International 2003;138(1-3):91. [Presents the analysis of marijuana that was treated with naphthalene as a pesticide in a moderate sized home grow operation (80 plants); naphthalene was found in high concentration in the marijuana.]

84) Galand N, Emouf D, Montigny F, Dollet J, Pothier J. Separation and identification of cannabis components by different planar chromatography techniques (TLC, AMD, OPLC). Journal of Chromatographic Science 2004;42(3):130.

85) Gambaro V, Dell'Acqua L, Fare F, Froldi R, Saligari E, Tassoni G. Determination of primary active constituents in cannabis preparations by high-resolution gas chromatography/flame ionization detection and high-performance liquid chromatography/UV detection. Analytica Chimica Acta 2002;468(2):245. [Presents a comparative study between the two title techniques for the complete, quantitative analysis of all the active constituents in cannabis. Validation studies were carried out on hashish.]

86) Gilmore S, Peakall R. Isolation of microsatellite markers in Cannabis sativa L. (marijuana). Molecular Ecology Notes 2003;3(1):105. [Fifteen markers were identified that can characterize genetic diversity in cultivated and natural marijuana populations.]

87) Gilmore S, Peakall R, Robertson J. Short tandem repeat (STR) DNA markers are hypervariable and informative in Cannabis sativa: Implications for forensic investigations. Forensic Science International 2003;131(1):65. [Presents a profiling study of 93 individual cannabis plants of widespread origin, using 5 STR markers. The authors claim that source determination is possible using the presented methods.]

88) Hsieh, H-M, Hou R-J, Tsai L-C, Wei C-S, Liu S-W, Huang L-H, Kuo Y-C, Linacre A, Lee JC-I. A highly polymorphic STR locus in Cannabis sativa. Forensic Science International 2003;131(1):53. [Reports the isolation of a short tandem repeat locus from Cannabis sativa.]

89) Miller Coyle H, Shutler G, Abrams S, Hanniman J, Neylon S, Ladd C, Palmbach T, Lee HC. A simple DNA extraction method for marijuana samples used in amplified fragment length polymorphism (AFLP) analysis. Journal of Forensic Sciences 2002;48(2):343. [Presents an AFLP technique for creating a DNA profile for different plant varieties.]

90) Szabady B, Hidvegi E, Nyiredy S. Determination of neutral cannabinoids in hemp samples by overpressured-layer chromatography. Chromatographia 2002;56(Suppl. S):S165. [The overpressured-layer chromatographic separation of neutral cannabinoids (delta(9)-tetrahydrocannabinol, cannabidiol, cannabinol, cannabigerol and cannabichromene) was achieved on amino HPTLC plates, using dichloromethane as the mobile phase.]

91) Wojtasik E, Anyzewska M, Arent I. The optimization of the separation conditions for

cannabinoids from Cannabis sativa L. var. Indica and application of the method to determine the content of delta(9)-tetrahydrocannabinol in plant material. Journal of Liquid Chromatography and Related Technologies 2002;25(6):949.

Mescaline/Peyote:

92) Maloney DC. Extraction of mescaline from peyote. Microgram 2001;34(8):205.

Methadone:

93) Kelly T, Doble P, Dawson M. Chiral separation of methadone, 2-ethylidene-1,5-dimethyl-3,3-diphenylpyrrolidine (EDDP) and 2-ethyl-5-methyl-3,3-diphenyl-1-pyrroline (EMDP) by capillary electrophoresis using cyclodextrin derivatives. Electrophoresis 2003;24(12-13):2106. [Presents a stereoselective method for the simultaneous determination of methadone and its two principal metabolites.]

Methylenedioxyamphetamines and Related Compounds:

94) Aalberg L, DeRuiter J, Noggle FT, Sippola E, Clark CR. Chromatographic and spectroscopic methods of identification for the side-chain regioisomers of 3,4-methylene-dioxyphenethylamines related to MDEA, MDMMA, and MBDB. Journal of Chromatographic Science 2003;41(5):227. [Presents the synthesis and GC and GC/MS analyses of ten closely related 3,4-methylenedioxyphenethyl-amines all having a molecular weight of 207.]

95) Chan KB. A normal phase HPLC method for the quantitation of MDMA in illicit ecstasy tablets. Microgram 2001;34(9):237.

96) Fang C, Chung Y-L, Liu J-T, Lin C-H. Rapid analysis of 3,4-methylenedioxymeth-amphetamine: A comparison of non-aqueous capillary electrophoresis/ fluorescence detection with GC/MS. Forensic Science International 2002;125(2-3):142.

97) Huang YS, Liu JT, Lin LC, Lin CH. Chiral separation of 3,4-methylenedioxymeth-amphetamine and related compounds in clandestine tablets and urine by capillary electrophoresis/fluorescence spectroscopy. Electrophoresis 2003;24(6):1097. [MDA was also analyzed. Contrasts the title analysis with standard GC/MS methods.]

98) Kulikowska J, Celinski R, Soja A, Sybirska H. Identification study of tablets of unknown composition originating from illicit drug sale. Z-Zagadnien-Nauk-Sadowych

2002;49:99. [A study of Ecstasy tablets by TLC, UV, HPLC-DAD, and MS.]

99) Piette V, Parmentier F. Analysis of illicit amphetamine seizures by capillary zone electrophoresis. Journal of Chromatography A 2002;979:345. [Presents a CZE methodology for analysis of typical drugs found in Ecstasy tablets]

100) Pizarro N, Liebaria A, Cano S, Joglar J, Farre M, Segura J, de la Torre R. Stereochemical analysis of 3,4-methylenedioxymethamphetamine and its main metabolites by gas chromatography/mass spectrometry. Rapid Communications in Mass Spectrometry 2003;17:330. [Presents a derivatization procedure, followed by GC/MS analysis. The focus is for analysis of biological fluids].

101) Sagmuller B, Schwarze B, Brehm G, Schneider S. Application of SERS spectroscopy to the identification of (3,4-methylenedioxy)amphetamine in forensic samples utilizing matrix stabilized silver halides. Analyst 2001;126(11):2066.

102) Schneider RC, Kovar KA. Analysis of ecstasy with a monolithic reverse-phase column. Chromatographia 2003;57(5-6):287. [Presents an HPLC method that analyzes for amphetamine, MDMA, MDEA, and N-methyl-1-(3,4-methylenedioxyphenyl)-2-butanamine in suspected ecstasy tablets.]

103) Schneider RC, Kovar K-A. Analysis of ecstasy tablets: Comparison of reflectance and transmittance near infrared spectroscopy. Forensic Science International 2003;134(2-3):187. [Presents analyses of mixed composition tablets by the title techniques; transmittance mode was found to be better than reflectance mode.]

Methylphenidate:

104) Denk OA, Watson DG, Skellern GG. Chiral analysis of methylphenidate and dextromoramide by capillary electrophoresis. Journal of Chromatography B - Analytical Technologies in the Biomedical and Life Sciences 2001;761(1):61.

105) Schneiderman E, Gratz SR, Stalcup AM. Optimization of preparative electrophoretic chiral separation of Ritalin enantiomers. Journal of Pharmaceutical and Biomedical Analysis 2002;27(3-4):639.

Morphine, Codeine, and Related Opium Alkaloids:

106) Baeyens WRG, VanderWeken G, Smet E, GarciaCampana AM, Remon JP. Comparison

of morphine and hydromorphone analysis on reversed phase columns with different diameters. Journal of Pharmaceutical and Biomedical Analysis 2003;32(4-5):913. [Presents the analysis of the title compounds by HPLC on 2, 3, and 4 mm i.d. RP columns with UV detection.]

107) Barnett NW, Hindson BJ, Lewis SW, Jones P, Worsfold PJ. Soluble manganese(IV); A new chemiluminescence reagent. Analyst 2001;126(10):1636. [Includes application for trace detection of morphine and codeine.]

108) Dams R, Benijts T, Lambert WE, DeLeenheer AP. Simultaneous determination of in total 17 opium alkaloids and opioids in blood and urine by fast liquid chromatography - diode-array detection - fluorescence detection, after solid-phase extraction. Journal of Chromatography B - Analytical Technologies in the Biomedical and Life Sciences 2002;773(1):53.

109) Degim T, Akay C, Buyukafsar K, Cevheroglu S. Simultaneous determination of codeine and ethyl morphine HCl in tablet formulations using LC. Journal of Pharmaceutical and Biomedical Analysis 2001;26(1):15.

110) Dinc E, Baleanu D, Onur F. Simultaneous spectrophotometric analysis of codeine phosphate, acetylsalicylic acid, and caffeine in tablets by inverse least-squares and principal component regression techniques. Analytical Letters 2002;35(3):545.

111) Garrido JMPJ, Delerue-Matos C, Borges F, Macedo TRA, Olivera-Brett AM. Electroanalytical determination of codeine in pharmaceutical preparations. Analytical Letters 2002;35(15):2487. [Presents a square wave voltametric (SWV) method and a flow injection analysis system with electrochemical detection (FIA-EC) for determination of codeine in various pharmaceutical preparations. Limitations with certain co-ingredients (e.g., acetaminophen) are discussed.]

112) Hosztafi S, Noszal B. Determination of morphine and its derivatives, by means of luminescence analysis. Acta Pharmaceutica Hungarica 2002;72(3):191. [A minor review of the title topic.]

113) Hood DJ, Cheung HY. A chromatographic method for rapid and simultaneous analysis of codeine phosphate, ephedrine HCl, and chlorpheniramine maleate in cough-cold syrup formulation. Journal of Pharmaceutical and Biomedical Analysis 2003;30(5):1595. [Presents a reversed phase HPLC with UV detection method for analysis of a cough-cold syrup product.]

114) Kartal M. LC method for the analysis of paracetamol, caffeine and codeine phosphate in pharmaceutical preparations. Journal of Pharmaceutical and Biomedical Analysis 2001;26(5-6):857.

115) Martos NR, Diaz AM, Navalon A, Capitan-Vallvey LF. Spectrofluororimetric determination of acetylsalicylic acid and codeine mixtures in pharmaceuticals. Analytical Letters 2001;34(4):579.

116) Molina-Diaz A, Ramos-Martos N, Navalon A, Capitan-Vallvey LF. Simultaneous determination of codeine and pyridoxine in pharmaceutical preparations by first derivative spectrofluorimetry. JAOAC International 2002;85(4):861.

117) Ramos-Martos N, Aguirre-Gomez F, Molina-Diaz A, Capitan-Vallvey LF. Application of liquid chromatography to the simultaneous determination of acetylsalicylic acid, caffeine, codeine, paracetamol, pyridoxine, and thiamine in pharmaceutical preparations. JAOAC International 2001;84(3):676.

118) Stubberud K, Forsberg A, Callmer K, Westerlund D. Partial filling micellar electrokinetic chromatography optimization studies of ibuprofen, codeine and degradation products, and coupling to mass spectrometry. Electrophoresis 2002;23(4):572.

119) Stubberud K, Callmer K, Westerlund D. Partial filling - micellar electrokinetic chromatography optimization studies of ibuprofen, codeine and degradation products, and coupling to mass spectrometry: Part II. Electrophoresis 2003;24(6):1008. [For analysis of pharmaceutical preparations.]

120) Sun GX, Wang Y, Sun YQ. The quantitative determinations of glycyrrhizic acid, glycyrrhetinic acid, morphine, and sodium benzoate in compound liquorice tablets by HPCE. Journal of Liquid Chromatography and Related Technologies 2003;26(1):43. [Presents a CZE/UV method to perform the title analysis.]

121) Zakaria P, Macka M, Haddad PR. Separation of opiate alkaloids by electrokinetic chromatography with sulfated cyclodextrin as a pseudo-stationary phase. Journal of Chromatography A 2003;985(1-2):493. [Presents an EKC method for separation of morphine, thebaine, 10-hydroxythebaine, codeine, oripavine, and laudanine.]

<u>Opiate Alkaloids</u>:

122) Kuznetsov PE, Aparkin AM, Zlobin VA, Nazarov GV, Kosterin PV, Lyubun' EV,

Shcherbakov AA. Analysis of opiates by spin-lattice relaxation techniques. Pharmaceutical Chemistry Journal (English translation of Khimiko-Farmatsevticheskii Zhurnal) 2002;36(6):331. [Presents the use of the title technique to detect opiates in plasma.]

123) Pennanen K, Kotiaho T, Huikko K, Kostiainen R. Identification of ozone-oxidation products of oxycodone by electrospray ion trap spectrometry. Journal of Mass Spectrometry 2001;36(7):791.

Opium (and Opium Poppies):

124) Lurie IS, Panicker S, Hays PA, Garcia AD, Geer BL. Use of dynamically coated capillaries with added cyclodextrins for the analysis of opium using capillary electrophoresis. Journal of Chromatography A 2003;984(1):109. [Presents a rapid, precise, accurate, and robust method for analysis of the major opium alkaloids in either opium gum or latex. The same conditions may be utilized to analyze LSD exhibits.]

125) Reddy MM, Suresh V, Jayashanker G, Rao BS, Sarin RK. Application of capillary zone electrophoresis in the separation and determination of the principal gum opium alkaloids. Electrophoresis 2003;24(9):1437. [The presented method does not require sample purification or derivatization.]

126) Szucs Z, Szabady B, Szatmary M, Cimpan G, Nyiredy S. High-throughput analytical strategy with combined planar and column liquid chromatography for improvement of the poppy (Papaver somniferum L.) with a high alkaloid content. Chromatographia 2002;56(Suppl. S):S49. [Four different liquid chromatographic methods (multi-layer overpressured-layer chromatography (MLOPLC), normal-phase high-performance thin-layer chromatography (NPHPTLC), rapid reversed-phase high-performance liquid chromatography (RPHPLC), and a second, different RPHPLC method, were used for determination of alkaloid content of over 15,000 poppy capsule samples.]

Overview/Polydrug:

127) Peinhardt G. Identification of illegal drugs in pharmacy laboratories: Combination of thin layer chromatography and immunochemical quick tests. PZ Prisma 2002;9(2):99. [A combination of isolation and analytical methods are presented for detection and determination of cannabis, opiates, heroin, cocaine, amphetamines, designer drugs, and LSD.]

Pethidine:

128) Quaglia MG, Farina A, Donati E, Cotechini V, Bossu E. Determination of MPTP, a toxic impurity of pethidine. Journal of Pharmaceutical and Biomedical Analysis 2003;33(1):1. [Presents the use of CE, MECK, and RP-HPLC to analyze for pethidine and MPTP.]

Phenethylamines (including mixtures of Amphetamines, Methylenedioxy-amphetamines, and Related Compounds):

129) CampinsFalco P, VerduAndres J, HerraezHernandez R. Separation of the enantiomers of primary and secondary amphetamines by liquid chromatography after derivatization with (-)-1-(9-fluorenyl)ethyl chloroformate. Chromatographia 2003;57(5-6):309. [Analysis of amphetamine, methamphetamine, ephedrine, pseudoephedrine, MDA, MDMA, and MDE are reported. A variety of sample types (not specified in the abstract) were analyzed.]

130) Cheng W-C, Lee W-M, Chan -F, Phil M, Tsui P, Dao K-L. Enantiomeric separation of methamphetamine and related analogs by capillary zone electrophoresis: Intelligence study in routine methamphetamine seizures. Journal of Forensic Sciences 2002;47(6):1248. [The simultaneous separation of ephedrine, pseudoephedrine, and methamphetamine using CZE with beta-cyclodextrin as a chiral selector is presented. Application to the analysis of seized drugs is discussed.]

131) Iwata YT, Garcia A, Kanamori T, Inoue H, Kishi T, Lurie IS. The use of a highly sulfated cyclodextrin for the simultaneous chiral separation of amphetamine-type stimulants by capillary electrophoresis. Electrophoresis 2002;23(9):1328.

132) Iwata YT, Kanamori T, Ohmae Y, Tsujikawa K, Inoue H, Kishi T. Chiral analysis of amphetamine-type stimulants using reversed-polarity capillary electrophoresis/positive ion electrospray ionization tandem mass spectrometry. Electrophoresis 2003;24(11):1770. [Presents the specialized CE/MS-MS analyses of a variety of ATS's, ranging from precursor ephedrines to methylenedioxy- substituted drugs.]

133) Kato N, Ogamo A. A TLC visualization reagent for dimethylamphetamine and other abused tertiary amines. Science Justice 2001;41(4):239.

134) Lurie IS Bethea MJ, McKibben TD, Hays PA, Pellegrini P, Sahai R, Garcia AD, Weinberger R. Use of dynamically coated capillaries for the routine analysis of methamphetamine, amphetamine, MDA, MDMA, MDEA, and cocaine using capillary

electrophoresis. Journal of Forensic Sciences 2001;46(5):1025.

Piperazines:

135) de Boer D, Bosman IJ, Hidvegi E, Manzoni C, Benko AA, dos Reys LJAL, Maes RAA. Piperazine-like compounds: A new group of designer drugs-of-abuse on the European market. Forensic Science International 2001;121(1-2):47.

136) Kercheval JC. GC/MS analysis of BZP and TFMPP. Mid-Atlantic Association of Forensic Sciences Newsletter 2004;32(2) (no page numbers). [Presents the GC/MS analyses of 1-benzylpiperazine and 1-(3-trifluoromethylphenyl)-piperazine.]

137) Wikstroem M, Holmgren P, Ahlner J. N+Benzylpiperazine - A new drug of abuse in Sweden. Journal of Analytical Toxicology 2004;28(1):67. [A brief overview reporting the occurrence of BZP in Sweden, also reporting a law enforcement network which enabled rapid identification of BZP cases.]

Polydrug:

138) Bazylak G, Nagels LJ. Simultaneous high-throughput determination of clenbuterol, ambroxol and bromhexine in pharmaceutical formulations by HPLC with potentiometric detection. Journal of Pharmaceutical and Biomedical Analysis 2003;32(4-5):887. [The title analysis was performed using six different isocratic systems.]

139) Benson AJ, Sabucedo A, Furton KG. Detection and identification of date rape drugs gamma-hydroxybutyrate (GHB), flunitrazepam (Rohypnol), lysergic acid diethylamide (LSD), scopolamine, diphenhydramine, and ketamine by refocused solid phase microextraction high performance liquid chromatography (SPME/HPLC) and solid phase microextraction high performance liquid chromatography mass spectrometry (SPME/HPLC/MS). Proceedings of the American Academy of Forensic Sciences 2003;9:29. [Presents a study of the SPME followed by HPLC and HPLC/MS for analysis of the referenced drugs.]

140) Bishop SC, Lerch MA, McCord BR. A micellar electrokinetic screening for common sexual assault drugs. Proceedings of the American Academy of Forensic Sciences 2004;10:70. [For detection of eight (unspecified) benzodiazepines, GHB, and GBL.]

141) Bishop SC, Lerch M, McCord BR. Micellar electrokinetic chromatographic screening method for common sexual assault drugs administered in beverages. Forensic Science

International 2004;141 (1):7. [The title analysis was applied for detection of GHB, GBL, and eight benzodiazepines (unspecified in abstract) in spiked beverages.]

142) Blanco M, Valverde I. Application of micellar electrokinetic chromatography to the quality control of a pharmaceutical preparation containing three bronchodilators. Electrophoresis 2002;23(4):578.

143) Cherkaoui S, Rudaz S, Varesio E, Veuthey JL. On-line capillary electrophoresis-electrospray mass spectrometry for the stereoselective analysis of drugs and metabolites. Electrophoresis 2001;22(15):3308. [Includes analyses of amphetamines, methadone, and tropane alkaloids.]

144) Cherkaoui S, Veuthey JL. Use of negatively charged cyclodextrins for the simultaneous enantioseparation of selected anesthetic drugs by capillary electrophoresis-mass spectrometry. Journal of Pharmaceutical and Biomedical Analysis 2002; 27(3-4):615. [Presents the enantioseparation of bupivacaine, mepivacaine, ketamine, and prilocaine.]

145) Geraghty E, Wu C, McGann W. Effective screening for "Club Drugs" with dual mode ion trap mobility spectrometry. International Journal for Ion Mobility Spectrometry 2002;5(3):41. [Presents a study on the analysis of various "Rave" drugs by dual mode ITMS, including: Ketamine, GHB, ephedrine, flunitrazepam, methamphetamine, MDA, amphetamine, and MDMA.]

146) Ishii A, Watanabe-Suzuki K, Seno H, Suzuki O, Katsumata Y. Application of gas chromatography-surface ionization organic mass spectrometry to forensic toxicology. Journal of Chromatography B - Analytical Technologies in the Biomedical and Life Sciences 2002;776(1):3. [The title technique detects phencyclidine (PCP), pethidine, pentazocine, and MPTP and its derivatives in human body fluids, with high sensitivity and selectivity.]

147) Katagi M, Tsutsumi H, Miki A, Nakajima K, Tsuchihashi H. Analyses of clandestine tablets of amphetamines and their designer drugs encountered in recent Japan [sic]. Japanese Journal of Forensic Toxicology 2002;20(3):303. [Presents analyses of various tablets recently seized in Osaka (including tablets containing MDMA, PMA, 2C-T-7, and various tryptamines).]

148) Klingmann A, Skopp G, Aderjan R. Analysis of cocaine, benzoylecgonine, ecgonine methyl ester, and ecgonine by high pressure liquid chromatography-API mass spectrometry and application to a short-term degradation study of cocaine in plasma.

Journal of Analytical Toxicology 2001;25(6):425.

149) Lurie IS. Capillary electrophoresis analysis of a wide variety of seized drugs on the same dynamically coated capillary. Proceedings of the American Academy of Forensic Sciences 2004;10:107. [Drug types include phenethylamines, cocaine, heroin, oxycodone, morphine, LSD, psilocybin, opium, and GHB/GBL; both qualitative and quantitative results are achieved.]

150) Madej K, Wozniakiewicz M. Application of capillary electrophoresis to analysis of tricyclic psychotropic drugs. Z Zagadnien Nauk Sadowych 2002;52:52. [Presents the use of CZE and MECC for analysis of both blood and pharmaceutical preparations of phenothiazines and tricyclic psychotropic drugs.]

151) Morehead RA. Optimizing HPLC separation of antidepressant drugs through stationary phase selection. Proceedings of the American Academy of Forensic Sciences 2003;9:304. [Includes a discussion of the primary separation mechanisms for 14 drugs; the referenced drugs were not identified.]

152) Pihlainen K, Kostiainen R. Effect of the eluant on enantiomer separation of controlled drugs by liquid chromatography - ultraviolet absorbance detection - electrospray ionisation tandem mass spectrometry using vancomycin and native beta-cyclodextrin chiral stationary phases. Journal of Chromatography A 2004;1033(1):91. [Presents the title study on nine amphetamine derivatives (not specified in abstract), methorphan, and propoxyphene. 14 seized drug samples (not specified in abstract) were analyzed using the optimized methodologies.]

Propoxyphene:

153) Magoon T, Ota K, Jakubowski J, Nerozzi M, Werner TC. The use of neutral cyclodextrins as additives in capillary electrophoresis for the separation and identification of propoxyphene enantiomers. Analytical and Bioanalytical Chemistry 2002;373(7):628. [Baseline separation was achieved in approximately 6 minutes.]

Psilocybin Mushrooms, Psilocybin, and Psilocin:

154) Linacre A, Cole M, Chun-I Lee J. Identifying the presence of "magic mushrooms" by DNA profiling. Science and Justice 2002;42(1):50. [Presents a minor review of DNA-based analyses of psilocybe and panaeolus mushrooms. The techniques are especially valuable for cases of dry, powdered material where microscopic

characterization is impossible.]

155) Mahler, H, Daldrup T. Quick detection of psilocin in mushroom culture substrates. GTFCh-Symposium: Toxikologische Aspekte der Sterbehilfe - Neue Drogen: Chemische, Analytische und Toxikologische Aspekte, Beitraege zum Symposium der Gesellschaft fuer Toxikologische und Forensische Chemie, 12th, Mosbach, Germany, Apr. 26 - 28, 2001 2001;(Pub 2001):242. [Psilocin was isolated and identified from mushroom culture substrates with HPLC/UV and GC/MS.]

156) Nugent KG, Saville BJ. Forensic analysis of hallucinogenic fungi: A DNA-based approach. Forensic Science International 2004;140(2-3):147. [Presents the title study.]

157) Sarwar M, McDonald JL. A rapid extraction and GC/MS methodology for the identification of psilocyn in mushroom/chocolate concoctions. Microgram Journal 2003;1(3-4):177.

158) Tsujikawa K, Kanamori T, Iwata Y, Ohmae Y, Sugita R, Inoue H, Kishi T. Morphological and chemical analysis of magic mushrooms in Japan. Forensic Science International 2003;138(1-3):85. [Analyses included the complementary use of a scanning electron microscope (SEM), along with standard microscopy and HPLC/UV. Listed substrates included Psilocybe cubensis and Copelandia.]

***Psychotria viridis*:**

159) Blackledge RD, Taylor CM. Psychotria viridis - A botanical source of dimethyl-tryptamine (DMT). Microgram Journal 2003;1(1-2):18. [Presents both forensic and botanical profiles for the title substance.]

***Salvia divinorum*:**

160) Blaszczyk P, Hernik H, Ehrmann R. Salvinorin A (Salvinoryna A). Problemy Kryminalistyk 2002;237:48. [Presents a GC/MS method for analysis of Salvia divinorum.]

Steroids:

161) Catlin DH, Ahrens BD, Kucherova Y. Detection of norbolethone, an anabolic steroid never marketed, in athlete's urine. Rapid Communications in Mass Spectrometry 2002;16(13):1273. [Presents analysis by GC/MS. The authors note that the title

compound has never been commercially marketed, and suggest that a clandestine source may therefore be in operation.]

162) Hussain AA, Al-Bayatti AA, Dakkuri A, Okochi K, Hussain MA. Testosterone-17-(beta)-N,N-dimethylglycinate hydrochloride: A prodrug with a potential for nasal delivery of testosterone. Journal of Pharmaceutical Sciences 2002;91(3):785.

163) Leinonen A, Kuuranne T, Kostiainen R. Liquid chromatography/mass spectrometry in anabolic steroid analysis-optimization and comparison of three ionization techniques: Electrospray ionization, atmospheric pressure chemical ionization and atmospheric pressure photoionization. Journal of Mass Spectrometry 2002;37(7):693. [The presented LC/MS/MS technique exhibited high sensitivity and specificity for the detection of various steroids, and may be a suitable technique for screening for the abuse of anabolic steroids.]

164) Lommen A, Schilt R, Weseman J, Roos AH, vanVelde JW, Nielen MWF. Application of 1D H-1 NMR for fast non-targeted screening and compositional analysis of steroid cocktails and veterinary drug formulations administered to livestock. Journal of Pharmaceutical and Biomedical Analysis 2002;28(1):87.

165) Nozaki O. Steroid Analysis for medical diagnosis. Journal of Chromatography A 2001;935(1-2):267. [Includes analysis of anabolic steroids; focus is on analysis of biological matrices.]

(Designer) Tryptamines (see also Psilocybin):

166) Ausili PT, Negrusz A, Dal Cason TA, Larsen AK, Schlemmer RF, Tella SR. Tryptamines and other psychotropic (mind altering) substances: Analysis, toxicology, and pharmacology. Proceedings of the American Academy of Forensic Sciences 2004;10:13. [A comprehensive overview of the recent increase in psychotropics, including evaluation and control issues.]

167) Meatherall R, Sharma P. Foxy, a designer tryptamine hallucinogen. Journal of Analytical Toxicology 2003;27(5):313. [Primary focus is analysis of biological fluids; however, includes a small scale mass spectra (from GC/MS) of "Foxy" (5-methoxy-N,N-diisopropyltryptamine).]

168) Zimmerman MM. The identification of 5-methoxy-alpha-methyltryptamine. Microgram Journal 2003;1(3-4):158. [Uses color tests and GC/MS).]

Zaleplon:

169) Tang B, Wang X, Jia BX, Niu JY, Wei Y, Chen ZZ, Wang Y. Simple, rapid, and sensitive spectrofluorimetric determination of Zaleplon in micellar medium. Analytical Letters 2003;36(14):2985.

Zolpidem:

170) ElZeany BA, Moustafa AA, Farid NF. Determination of zolpidem hemitartrate by quantitative HPTLC and LC. Journal of Pharmaceutical and Biomedical Analysis 2003;33(3):393. [Presents the analyses of zolpidem in the presence of its degradation product by TLC-UV densitometry and by HPLC with UV detection.]

Zopiclone:

171) Meng Z-Y. Properties of a newly produced hypnotic "Imovane" and its determination. Guangpu Shiyanshi 2003;20(3):471. [Presents HPLC and GC-MS data for the title compound (principal component is Zopiclone).]

Miscellaneous:

172) Bartlett V. HPLC analysis of narcotic/acetaminophen admixtures. What to do if a compendium method doesn't work. The Restek Advantage 2002;3:6. [Discusses modifications to established methods for separating admixtures of compounds with similar structures.]

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:

173) Courtney M, Ekis TR. O, dem bones. Systematic analysis of remnants from "Nazi" methamphetamine laboratories. Journal of the Clandestine Laboratory Investigating Chemists Association 2003;13(1):17. [Presents a systematic approach to analyzing the reaction dregs recovered from Birch reduction laboratories, for the purpose of identifying the original reactants, extraction solvents, and products.]

174) Crow BM. Production of anhydrous ammonia used to produce methamphetamine via the Birch reduction method. Journal of the Clandestine Laboratory Investigating Chemists Association 2004;14(1):18.

175) Dimitroff D. Psilocybin mushroom cultivation. Journal of the Clandestine Laboratory Investigating Chemists Association. 2004;14(2):11. [An overview of the title topic.]

176) Hough M, Warburton H, Few B, May T, Man LH, Witton J, Turnbull PJ. A growing market. The domestic cultivation of cannabis. Report Joseph Rowntree Foundation 2003; pp. 1 - 45. [Presents an overview of domestic cultivation of cannabis in England and Wales.]

177) Laing R, Hugel J. Methods of illicit manufacture. Hallucinogens 2003:139. [A review

of the common illicit syntheses of a variety of hallucinogens.]

178) Person EC, Knops LA. Clandestine Ammonia Generation. Journal of the Clandestine Laboratory Investigating Chemists Association 2004;14(1):20.

179) Person EC, Knops LA, Northrop DM, Sheridan SP. "One-pot" methamphetamine manufacture. Journal of the Clandestine Laboratory Investigating Chemists Association. 2004;14(2):14. [Editor's Notes: Presents an evaluation of an Internet recipe.]

180) Potter GR. The growth of Cannabis growing: A study of urban Cannabis growers in the north of England. Report Sheffield University 2002; No. 00189486; pp. 1 - 20. [Presents an overview of the title topic.]

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:

181) Bakouri E, Van Rijn A. Dismantling of [a] clandestine laboratory in Greece. Science Justice 2001;41(3):213.

182) Borngasser J. Lab supplies go to the highest bidder: A brief analysis of clandestine methamphetamine laboratory supplies and methamphetamine precursors being sold on ebay®. Journal of the Clandestine Laboratory Investigating Chemists Association 2004;14(2):8.

183) De Haan JD, Angelos SA. Bubble, bubble, boom! Fires and explosions in clandestine drug laboratories. Proceedings of the American Academy of Forensic Sciences 2004;10:18. [A comprehensive overview of the title subject, for both arson investigators and forensic chemists.]

184) Hugel J, Pearson M, Evoy T. Drug Yield Calculator Version 3.2 Journal of the Clandestine Laboratory Investigating Chemists Association 2002;12(4):28. [Presents a computer program that calculates potential yield of common scheduled drugs when given a known amount of precursor and the synthetic route.]

185) Janusz A, Kirkbride KP, Scott TL, Naidu R, Perkins MV, Megharaj M. Microbial degradation of illicit drugs, their precursors, and manufacturing by-products: Implications for clandestine laboratory investigation and environmental assessment. Forensic Science International 2003;134(1):62. [Presents a study of the enviromental degradation of phenylacetone and methamphetamine sulfate at clandestine laboratory

dumpsites in Australia.]

186) Kubicz-Loring EJ, Downs AA, Miller SJ, Jolley JM, Allen PC. The clandestine laboratory - A recipe for disaster. Proceedings of the American Academy of Forensic Sciences 2002;8:17. [A workshop providing overviews of the investigation, chemistry, toxicology, and pathology of clandestine laboratories, especially methamphetamine laboratories.]

187) White MJ. National initiatives and issues related to clandestine laboratory investigations in Australia. Proceedings, 16th International Symposium on the Forensic Sciences, Canberra 2002(16):(No pps given). [An overview of major counter-drug laboratory initiatives in Australia during the time frame 1992-2002.]

Safety Issues - Case Reports:

188) Cameron M. Iodine: Inhalation Hazards, Detection, and Protection. Journal of the Clandestine Laboratory Investigating Chemists Association 2002;12(4):18. [Presents a safety overview of iodine, focusing on exposure as a result of clandestine laboratory raids.]

189) Willers LJ. The detection of phosphine gas produced from hydriodic acid and the evaluation of detection instruments for use in clandestine laboratory environments. Journal of the Clandestine Laboratory Investigating Chemists Association 2003;13(2):14. [Presents a comprehensive overview of the problem and a detailed evaluation of a number of electronic detection devices.]

Miscellaneous:

190) Kelly CA, Lawrence DS, Murray GM, Uy OM. Methamphetamine Synthesis Inhibition: Dissolving Metal Reductions. Journal of the Clandestine Laboratory Investigating Chemists Association 2002;12(3):10. [Presents the preliminary results of research investigating the development of inhibition reagents that would render anhydrous ammonia unusable for illicit manufacture of methamphetamine from ephedrine/ pseudoephedrine via the lithium/ammonia ("Nazi") reduction.]

191) Lewis LD. Method of disposing of hazardous wastes connected with criminal activity. US 20030176756 A1 18 Sep 2003, U.S. Pat Appl. Publ. CLASS: ICM: A62D003-00. NCL: 588213000. APLICATION: US 2002-100325 18 Mar 2002. [Presents the use of a portable incinerator (however, only selected waste materials are suitable for

destruction).]

192) Worley D. Evaluation of ammonium test paper. Journal of the Clandestine Laboratory Investigating Chemists Association 2002;12(2):17.

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:

193) Brunner H. Narcotic drug methohexital: Synthesis by enantioselective catalysis. Chirality 2001;13(8):420.

194) Chan KB. The identification, purification, and authentication of some reference drug standards. Microgram 2001;34(8):214.

195) Jarikote DV, Siddiqui SA, Rajagopal R, Daniel T, Lahoti RJ, Srinivasan KV. Room temperature ionic liquid promoted synthesis of 1,5-benzodiazepine derivatives under ambient conditions. Tetrahedron Letters 2003;44(9):1835. [Presents a novel synthetic approach to the title compounds.]

196) Khedkar V, Tillack A, Michalik M, Beller M. Efficient on-pot synthesis of tryptamines and tryptamine homologues by amination of chloroalkynes. Tetrahedron Letters 2004;45(15):3123.

197) Klemenc S. 4-Dimethylaminopyridine as a catalyst in heroin synthesis. Forensic Science International 2002;129(3):194. [Presents a study on the acetylation of morphine using 4-dimethylaminopyridine (4-DMAP) as a catalyst.]

198) Kozma D, Fogassy E. Solvent-free optical resolution of N-methylamphetamine by distillation after partial diastereoisomeric salt formation. Chirality 2001;13(8):428.

199) Pizarro N, delaTorre R, Farre M, Segura J, Liebaria A, Joglar J. Synthesis and capillary electrophoretic analysis of enantiomerically enriched reference standards of MDMA and its main metabolites. Bioorganic and Medicinal Chemistry 2002;10(4):1085. [Includes the synthesis of enantiomerically enriched (S)-3,4-methylenedioxymethamphetamine.]

200) Pozarentzi M, Stephanidou-Stephantou J, Tsoleridis CA. An efficient method for the synthesis of 1,5-benzodiazepine derivatives under microwave irradiation without solvent. Tetrahedron Letters 2002;43(9):1755.

201) Shirota O, Hakamata W, Goda Y. Concise large-scale synthesis of psilocin and psilocybin, principal hallucinogenic constituents of "Magic Mushroom" [sic]. Journal of Natural Products 2003;66(6):885.

202) Trost BM, Tang WP. Enantioselective synthesis of (-)-codeine and (-)-morphine. Journal of the American Chemical Society 2002;124(49):14542.

203) Van Zyl EF. A survey of reported synthesis of methaqualone and some positional and structural isomers. Forensic Science International 2001;122(2-3):142.

204) William AD, Kobayashi Y. Synthesis of tetrahydrocannabinols based on an indirect 1,4-addition strategy. Journal of Organic Chemistry 2002;67(25):8771. [Presents a novel synthesis route to optically active THC and related compounds.]

205) Yoshida H, Shirakawa E, Honda Y, Hiyama T. Addition of ureas to arynes: Straightforward synthesis of benzodiazepine and benzodiazocine derivatives. Angewandte Chemie - International Edition 2002;41(17):3247.

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):

207) Ballany J, Caddy B, Cole M, Finnon Y, Aalberg L, Janhunen K, Sippola E, Andersson K, Bertler C, Dahlen J, Kopp I, Dujourdy L, Lock E, Margot P, Huizer H, Poortman A, Kaa E, Lopes A. Development of a harmonised pan-European method for the profiling of amphetamines. Science Justice 2001;41(3):193.

208) Blachut D, Czarnocki Z, Wojtasiewicz K. alpha-Phenylethylamine in illegally produced amphetamine. Forensic Science International 2001;123(2-3):182.

209) Carter JF, Titterton EL, Grant H, Sleeman R. Isotopic changes during the synthesis of amphetamines. Chemical Communications 2002;21:2590. [Presents a study of the variations in C-13 and N-15 during various syntheses of amphetamine. The authors also claim that isotopic characterization can assist in identifying the synthetic origins of illicit MDMA and other amphetamines.]

210) Krawczyk W, Parczewski A. Application of chemometric methods in searching for illicit Leuckart amphetamine sources. Analytica Chimica Acta 2001;446:107. [Presents an impurity profiling methodology for linking amphetamine samples.]

211) Ottaviano V, Furnari C, Rosati F. Identification of di(beta-phenylisopropyl)amine as the main ingredient in illicit amphetamine tablets. Annali dell'Instituto Superiore di Sanita 2002;38(3):331. [Presents the identification of the title compound as the primary ingredient in several sets of amphetamine tablets sold in Rome during 1999-2000.]

Cocaine:

212) Chiarotti M, Marsili R, Moreda-Pineiro A. Gas chromatographic - mass spectrometric analysis of residual solvent trapped into illicit cocaine exhibits using head-space solid-phase microextraction. Journal of Chromatography B - Analytical Technologies in the Biomedical and Life Sciences 2002;772(2):249.

Cocaine and Heroin:

213) Galimov EM, Sevast'yanov VS, Kul'bachevskaya EV, Golyavin AA. Determination of isotopic compositions of carbon and nitrogen by the IRMS method: Implication for the source of narcotic substance origin. Doklady Earth Sciences 2003;393(8):1109. [Presents the title study on cocaine and heroin from different regions.]

Dimethylamphetamine:

214) Sato M, Hida M, Nagase H. Analysis of pyrolysis products of dimethylamphetamine. Journal of Analytical Toxicology 2001;25(5):304.

Heroin:

215) Bora T, Merdivan M, Hamamci C. Levels of trace and major elements in illicit heroin. Journal of Forensic Sciences 2002;47(5):959. [Ten elements in 44 illicit heroin samples were determined using electrothermal atomic absorption spectrometry or inductively coupled plasma-atomic emission spectrometry.]

216) Dams R, Benjits T, Lambert WE, Massart DL, De Leenheer AP. Heroin impurity profiling: Trends throughout a decade of experimenting. Forensic Science International 2001;123(2-3):81.

217) Dams R, Benjits T, Guenther W, Lambert W. Sonic spray ionization technology: Performance study and application to an LC/MS analysis on a monolithic silica column for heroin impurity profiling. Analytical Chemistry 2002;74(13):3206. [Enables analysis for 7 primary opium alkaloids in illicit heroin in 5 minutes.]

218) Dujourdy L, Barbati G, Taroni F, Gueniat O, Esseiva P, Anglada F, Margot P. Evaluation of links in heroin seizures. Forensic Science International 2003;131(2-3):171. [Presents a mathematical means for comparing chromatograms for degree of similarity, without using decision thresholds.]

219) Esseiva P, Dujourdy L, Anglada F, Taroni F, Margot P. A methodology for illicit heroin seizures comparison in a drug intelligence perspective using large databases. Forensic Science International 2003;132(2):139. [Presents a methodology for comparing heroin profiles. The authors claim that the methodology is solid, reliable, and simple.]

220) Hajdar M, Ruzdic E. Characterisation [sic] of heroin samples obtained in the area of the Federation of Bosnia and Herzegovina. Journal of Environmental Protection and Ecology 2003;4(4):873. [Presents the title survey, using GC/FID analysis to detect 8 opium alkaloids and 3 typical adulterants. The number of samples and the date range were not specified in the abstract.]

221) Lurie IS, Anex DS, Fintchenko Y, Choi W-Y. Profiling of impurities in heroin by capillary electrochromatography and laser induced fluorescence detection. Journal of Chromatography A 2001;924(1):421.

222) Zhang D, Shi X, Yuan Z, Ju H. Component analysis of illicit heroin samples with GC/MS and its application in source determination. Journal of Forensic Sciences 2004;49(1):81. [Presents a profiling analysis based on both GC and GC/MS. 500 samples were subclassified into nine groups using the presented techniques.]

<u>Marijuana</u>:

223) Carita EJ, Coyle HM, Ladd C, Palmbach TM, Lee HC. Expansion of an AFLP DNA marijuana (Cannabis sativa) state, national, and international database. Proceedings of the American Academy of Forensic Sciences 2004;10:79. [An overview of the use of AFLP to characterize marijuana.]

224) Germane-Presby J, Coyle HM, Palmbach TM, Pagliaro EM, Ladd C, Harper A, Lee HC. Development of a nationwide AFLP DNA database for marijuana (Cannabis sativa).

Proceedings of the American Academy of Forensic Sciences 2003;9:32. [A status report of an ongoing project by the Connecticut State Forensic Science Laboratory.]

Methamphetamine:

225) Inoue H, Kanamori T, Iwata YT, Ohmae Y, Tsujikawa K, Saitoh S, Kishi T. Methamphetamine impurity profiling using a 0.32 mm i.d. nonpolar capillary column. Forensic Science International 2003;135(1):42. [The presented method allows for determination of 24 different characteristic starting materials and manufacturing byproducts.]

226) Jacobs JL, Martinez FS, Skinner HF. Extraction of reaction by-products of common cold tablet ingredients via hydriodic acid reduction. Journal of the Clandestine Laboratory Investigating Chemists Association 2003;13(1):13. [Presents a study of the HI/red P reduction of a variety of co-ingredients found in ephedrine or pseudoephedrine based cold tablets.]

227) Koester CJ, Andresen BD, Grant PM. Optimum methamphetamine profiling with sample preparation by solid-phase microextraction. Journal of Forensic Sciences 2002;47(5):1002. [Volatile and semi-volatile components are recovered from illicit methamphetamine by SPME and analyzed by GC/MS. The method is claimed to be superior for profiling illicit methamphetamine.]

228) Kubicz-Loring E. Illicit methamphetamine profiling. Proceedings of the American Academy of Forensic Sciences 2003;9:30. [The impurity profiles of methamphetamine produced via the HI/red P reduction and Li/NH3 reductions are discussed and contrasted.]

229) Makino Y, Urano Y, Nagano T. Impurity profiling of ephedrines in methamphetamine by high-performance liquid chromatography. Journal of Chromatography A 2002;947(1):151.

230) Puthaviriyakorn V, Siriviriyasomboon N, Phorachata J, Pan-ox W, Sasaki T, Tanaka K. Identification of impurities and statistical classification of methamphetamine tablets (Ya-Ba) seized in Thailand. Forensic Science International 2002;126(2):105.

231) Vu D-TT. SPME/GC-MS characterization of volatiles associated with methamphetamine: Toward the development of a pseudomethamphetamine training material. Journal of Forensic Sciences 2001;46(5):1014.

4-Methoxyamphetamine and 4-Methoxymethamphetamine:

232) Blachut D, Maurin JK, Starosta W, Wojtasiewicz K, Czarnocki Z. (2S)-1-(4-Methoxy-phenyl)-N-[(1R)-2-(4-methoxyphenyl)-1-methylethyl]-2-propanamine in crude p-methoxyamphetamine (PMA) produced by the Leuckart method. Zeitschrift fuer Naturforschung B: Chemical Sciences 2002;57(5):593. [The title compound is established as a synthetic marker for Leuckart produced PMA.]

233) Blachut D, Wojtasiewicz K, Czarnocki Z. Identification and synthesis of some contaminants present in 4-methoxyamphetamine (PMA) prepared by the Leuckart method. Forensic Science International 2002;127(1-2):45.

234) Kochana J, Wilamowski J, Parczewski A, Surma M. Synthesis of standards of the most important markers of Leuckart p-methoxymethamphetamine (PMMA). Examination of the influence of experimental conditions and a drug diluent on SPE/TLC profiling. Forensic Science International 2003;134(2-3):207.

235) Waumans D, Bruneel N, Tytgat J. Anise oil as para-methoxyamphetamine (PMA) precursor. Forensic Science International 2003;133(1-2):159. [Presents a study of a large-scale PMA laboratory using anise oil as a precursor source. Includes impurity profiling studies that identified marker compounds for this synthesis.]

236) Waumans D, Bruneel N, Hermans B, Tytgat J. A rapid and simple GC/MS screening method for 4-methoxyphenol in illicitly prepared 4-methoxy-amphetamine (PMA). Microgram Journal 2003;1(3-4):184. [Confirms that 4-methoxyphenol is a marker compound for syntheses of PMA starting from anethole.]

Methylenedioxyamphetamines:

237) Armellin S, Brenna E, Fronza G, Fuganti C, Pinciroli M, Serra S. Establishing the synthetic origin of amphetamines by H-2 NMR spectroscopy. Analyst 2004;129(2):130. [The title study was applied to nine samples of N+acetyl-MDA.]

238) Bell SEJ, Barrett LJ, Burns DT, Dennis AC, Speers SJ. Tracking the distribution of "ecstasy" tablets by Raman composition profiling: A large scale feasibility study. Analyst 2003;128(11):1331. [Approximately 1500 tablets (all primarily MDMA) from different seizures in Northern Ireland were analyzed and found to have significant differences in their Raman spectra due to the presence of impurities and the degree of hydration of the MDMA. The results indicated that sample-sample comparisons could be

accomplished using Raman spectroscopy.]

239) Carter JF, Titterton EL, Murray M, Sleeman R. Isotopic characterization of 3,4-methylenedioxyamphetamine and 3,4-methylenedioxymethylamphetamine (Ecstasy). Analyst 2002;127(6):830. [Via analysis by IRMS and Deuterium NMR.]

240) Cheng W-C, Poon N-L, Chan M-F. Chemical profiling of 3,4-methylenedioxymeth-amphetamine (MDMA) tablets seized in Hong Kong. Journal of Forensic Sciences 2003;48(6):1249. [Presents an overview of the results of analysis for 600,000 ecstasy tablets (2,600 cases) seized in Hong Kong during 2000 - 2001.]

241) Gimeno, P, Besacier F, Chaudron-Thozet H, Girard J, Lamotte A. A contribution to the chemical profiling of 3,4-methylenedioxymethamphetamine (MDMA) tablets. Forensic Science International 2002;127(1-2):1. [An extensive study of profiling illicit MDMA tablets via a variety of chromatographic/mass spectrometric techniques.]

242) Gimeno P, Besacier F, Chaudron-Thozet H. Optimization of extraction parameters for the chemical profiling of 3,4-methylenedioxymethamphetamine (MDMA) tablets. Forensic Science International 2003;132(3):182. [Presents an optimized extraction procedure for recovery of impurities from MDMA tablets using diethyl ether extraction from a pH 11.5 buffered solution, followed by GC/MS analysis.]

243) Makino Y, Kurobane S, Miyasaka K, Nagano K. Profiling of ecstasy tablets seized in Japan. Microgram Journal 2003;1(3-4):169. [Presents the title study, focusing on tablets seized during the first half of CY-2002. Several trends are reported.]

244) Palhol F, Boyer S, Naulet N, Chabrillat M. Impurity profiling of seized MDMA tablets by capillary gas chromatography. Analytical and Bioanalytical Chemistry 2002;374(2):274. [Presents a study of MDMA tablets seized in France (total number not specified in the abstract). The authors claim that the results suggest that MDP2P is the most commonly used precursor, and that reductive amination is the most common synthetic route used to prepare the MDMA found in the tablets.]

245) Palhol F, Lamoureux C, Naulet N. N-15 Isotopic analyses: A powerful tool to establish links between seized 3,4-methylenedioxymethamphetamine (MDMA) tablets. Analytical and Bioanalytical Chemistry 2003;376(4):486. [Forty-three samples were analyzed by GC-Combustion-IRMS; the authors indicate that the technique can help establish common origins between samples.]

246) van der Peijl GJQ, van den Boom CPH, Bolck A, Dobney AM. XTC characterisation [sic] using ICPMS. Proceedings of the American Academy of Forensic Sciences 2004;10:53. [Presents the results of an ICPMS study of about 100 ecstasy samples.]

247) Titterton E, Carter J, Murray M, Sleeman R. Characterisation [sic] of ecstasy tablets by isotope ratio mass spectrometry. Proceedings of the 16th Meeting of the International Association of Forensic Sciences, Montpellier, France, September 2-7, 2002, pps 111-115. [MDA- and MDMA-based Ecstasy tablets were analyzed for deuterium, carbon-13, and nitrogen-15 to derive a isotopic fingerprint. Deuterium substitution was also determined via deuterium NMR.]

248) Vohlken BA, Layton SM. Instrumental separation of 3,4-methylenedioxy-amphetamine (MDA) from 1-(3,4-methylenedioxyphenyl)-2-propanol, a co-eluting compound. Microgram Journal 2003;1(1-2):32. [Presents a study of the referenced co-elution problem; includes the mass spectra for the title alcohol.]

249) Vu D-TT. Logo and headspace comparison for source determination of ecstasy seizures. Microgram 2001;34(9):244.

250) Waddell RJH, NicDaeid N, Littlejohn D. Classification of ecstasy tablets using trace metal analysis with the application of chemometric procedures and artificial neural network algorithms. Analyst 2004;129(3):235. [Presents a study of the practicality of ICP-MS for sample-sample comparisons. Several statistical analyses are evaluated.]

Opium and Opium Alkaoids:

251) 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. Forensic Science International 2004;140(2-3):175. [Reticuline was detected as its trimethylsilyl ethers, acetyl esters, and methyl ethers, in opium and in the urine of opium users. The results can be used to differentiate between opium and heroin users.]

252) Hosokawa K, Shibata T, Nakamura I, Hishida A. Discrimination among species of Papaver based on the plastid rp116 gene and the rp116-rp114 spacer sequence. Forensic Science International 2004;139(2-3):195. [Five of six species of papaver were distinguishable using the title technique.]

253) Kelly SA, Glynn PM, Madden SJ, Grayson DH. Impurities in a morphine sulfate drug product identified as 5-(hydroxymethyl)-2-furfural, 10-hydroxymorphine and

10-oxomorphine. Journal of Pharmaceutical Sciences 2003;92(3):485. [The referenced impurities were isolated by semi-prep HPLC and identified via MS and NMR. The presence of sugars in the drug formulation was implicated in the formation of the impurities.]

Occluded Solvent Analyses:

254) Camarasu CC. Unknown residual solvents identification in drug products by headspace solid phase microextraction gas chromatography-mass spectrometry. Chromatographia 2002;56(Suppl. S):S131. [Presents a sensitive headspace SPME method for the extraction of residual solvents from pharmaceutical products (the specific products were not detailed in the abstract). The SPME method appears to be more sensitive than static headspace techniques.]

Multi-Drug and Miscellaneous:

255) Binder R, Machata G, Stead H. Analysis of potassium permanganate as a narcotic drug precursor. Archiv fur Kriminologie 2003;211:160. [Thirty-one samples were analyzed for 9 metallic elements using emission spectroscopy and ICP-OES. The results did not allow classification of the samples according to origin.]

256) Lachance PA. Nutraceutical/drug/anti-terrorism safety assurance through traceability. Toxicology Letters 2004;150(1):25. [Presents an overview of techniques used to ensure traceability of nutraceutical products.]

257) Muratsu S, Ninomiya T, Kagoshima Y, Matsui J. Trace elemental analysis of drugs of abuse using synchrotron radiation total reflection X-ray fluorescence analysis (SR-TXRF). Journal of Forensic Sciences 2002;47(5):944. [Trace elements in amphetamine, cocaine, heroin, marijuana, methamphetamine, 3,4-methylenedioxy-methamphetamine, and opium were determined using the title technique.]

258) Palhol F. Contribution of isotopic analyses to the fight against drug trafficking. Actualite Chimique 2003;(8-9):27. [Appears to be an overview of the topic (not clear from the abstract).]

259) Shearer GL. Contaminant identification in pharmaceutical products. Microscope 2003;51(1):3. [A review of the title topic.]

260) Watanabe S, Shibata M, Kataoka K. Comparison of data obtained by various GC

methods for impurity profiling of stimulant drugs. Kanzei Chuo Bunsekishoho 2002;42:73. [Three different GC methods were used for impurity profiling of 10 typical impurities in 12 samples of stimulant drugs (not specified in abstract).]

261) Xu Q, Du L, Cao X. Simultaneous determination of 8 kinds of components in cannabis, opium, and heroin by gas chromatography. Fenxi Huaxue 2003;31(8):961. [Presents the title study using wide-bore GC.]

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:

262) Dash AK, Mo Y, Pyne A. Solid state properties of creatine monohydrate. Journal of Pharmaceutical Sciences 2002;91(3):708.

263) Dash AK, Sawhney A. A simple LC method with UV detection for the analysis of creatine and creatinine and its application to several creatine formulations. Journal of Pharmaceutical and Biomedical Analysis 2002;29(5):939. [Presents a simple and sensitive LC method for the determination of creatine and creatinine in various creatine supplement formulations.]

264) Persky AM, Hochhaus G, Brazeau GA. Validation of a simple liquid chromatography assay for creatine suitable for pharmacokinetic applications, determination of plasma protein binding, and verification of percent labeled claim of various creatine products. Journal of Chromatography B - Analytical Technologies in the Biomedical and Life Sciences 2003;794(1):157. [Includes the analysis of OTC creatine containing products.]

265) Wagner SD, Kaufer SW, Sherma J. Quantification of creatine in nutrition supplements by thin layer chromatography-densitometry with thermochemical activation of fluorescence quenching. Journal of Liquid Chromatography and Related Technologies

2001;24(16):2525.

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

266) Abourashed EA, El-Alfy AT, Khan IA, Walker L. Ephedra in perspective - A current review. Phytotherapy Research 2003;17:703. [A comprehensive review.]

267) Bicker W, Hebenstreit D, Lammerhofer M, Lindner W. Enantiomeric profiling in ephedrine samples by enantioselective capillary electrochromatography. Electrophoresis 2003;24(15):2532. [Presents a non-aqueous CEC method for the analysis of ephedrine.]

268) Chen HL, Chen XG, Pu QS, Hu ZD, Zhao ZF, Hooper M. Separation and determination of ephedrine and pseudoephedrine by combination of flow injection with capillary electrophoresis. Journal of Chromatographic Science 2003;41(1):1.

269) Jacob P, Haller CA, Duan MJ, Yu L, Peng M, Benowitz NL. Determination of ephedra alkaloid and caffeine concentrations in dietary supplements and biological fluids. Journal of Analytical Toxicology 2004;28(3):152.

270) Kim HK, Choi YH, Chang WT, Verpoorte R. Quantitative analysis of ephedrine analogues from ephedra species using H1-NMR. Chemical and Pharmaceutical Bulletin 2003;51(12):1382.

271) Li HX, Ding MY, Lv K, Yu JY. Separation and determination of ephedrine alkaloids and tetramethylpyrazine in ephedra sinica Stapf by gas chromatography-mass spectrometry. Journal of Chromatographic Science 2001;39(9):370.

272) Niemann RA, Gay ML. Determination of ephedrine alkaloids and synephrine in dietary supplements by column-switching cation exchange high-performance liquid chromatography with scanning-wavelength ultraviolet and fluorescence detection. Journal of Agricultural and Food Chemistry 2003;51(19):5630.

273) Palabiyik IM, Dinc E, Onur. Simultaneous spectrophotometric determination of pseudoephedrine hydrochloride and ibuprofen in a pharmaceutical preparation using ratio spectra derivative spectrophotometry and multivariate calibration techniques. Journal of Pharmaceutical and Biomedical Analysis 2004;34(3):473. [Presents a comparison of five different statistical evaluation methods for the title drug combination.]

274) Sullivan D, Wehrmann J, Schmitz J, Crowley R, Eberhard J. Determination of ephedra

alkaloids by liquid chromatography/tandem mass spectrometry. JAOAC International 2003;86(3):471. [Presents an LC-MS/MS methodology for determination of six major ephedra alkaloids in various substrates, ranging from raw ephedra to a high-protein drink mix containing ephedra.]

275) Tseng YL, Hsu H-R, Kuo F-H, Shieh M-H, Chang C-F. Ephedrines in over-the-counter cold medicines and urine specimens collected during sport competitions. Journal of Analytical Toxicology 2003;27(6):359. [Presents an analytical protocol using GC/NPD and GC/MS. Compounds include ephedrine, pseudoephedrine, phenylpropanolamine, and methylephedrine. 91 OTC medications were analyzed.]

276) Verdu-Andres J, Herraez-Hernandez R, Campins-Falco P. Analysis of enantiomers giving partially overlapped peaks by using different treatments of the chromatographic ultraviolet signals: Quantification of pseudoephedrine enantiomers. Journal of Chromatography A 2001;930(1-2):95.

277) Wallace K. Separation of ephedra alkaloids by GC-MS. Journal of the Clandestine Laboratory Investigating Chemists Association 2002;12(2):14.

278) Wedig M, Laug S, Christians T, Thunhorst M, Hozgrabe U. Do we know the mechanism of chiral recognition between cyclodextrins and analytes? Journal of Pharmaceutical and Biomedical Analysis 2002;27(3-4):531. [Chiral separation of ephedrine-type phenethylamines using various cyclodextrins is examined by CE and NMR.]

279) Ye NS, Gu XX, Zou H, Zhu RH. Separation and determination of ephedrine enantiomers by capillary electrophoresis using l-leucine as chiral selector. Chromatographia 2002;56(9-10):637. [The technique was applied to the analysis of ephedra plant extracts.]

280) Zhang XH, Ouyang J, Yang YP. A simple method for chiral separation of ephedrines using (R)-1-naphthylglycine and 3,5-dinitrobenzoic acid as stationary phase. Analytical Letters 2001;34(11):1851.

281) Zhang JY, Xie JP, Chen XG, Hu ZD. Sensitive determination of ephedrine and pseudoephedrine by capillary electrophoresis with laser-induced fluorescence detection. Analyst 2003;128(4):369. [The title technique was applied to the analysis of ephedra and ephedra preparations.]

282) Zhang JY, Xie JP, Liu JQ, Tian JN, Chen XG, Hu ZD. Microemulsion electrokinetic chromatography with laser-induced fluorescence detection for sensitive determination of

ephedrine and pseudoephedrine. Electrophoresis 2004;25(1):74. [The two substrates were derivatized with 4-chloro-7-nitrobenzo-2-oxa-1,3-diazol prior to analysis. The technique was applied to Chinese traditional herbal preparations.]

Phenylpropanolamine:

283) Rind FMA, Khuhawar MY, Rajper AD. HPLC determination of phenylpropanol-amine in pharmaceutical preparations using 4-dimethylaminobenzaldehyde as a derivatizing reagent. Journal of Pharmaceutical and Biomedical Analysis 2001;26(2):331.

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

284) Chen W, Liu F, Zhang X, Li KA, Tong S. The specificity of a chlorphenamine-imprinted polymer and its application. Talanta 2001;55(1):29 [Note: Chlorphenamine = chlorpheniramine].

285) Garcia A, Ruperez FJ, Marin A, delaMaza A, Barbas C. Poly(ethyleneglycol) column for the determination of acetaminophen, phenylephrine and chlorpheniramine in pharmaceutical formulations. Journal of Chromatography B - Analytical Technologies in the Biomedical and Life Sciences 2003;785(2):237. [Presents a rapid, isocratic HPLC method for determination of the three title compounds in cold medications. UV detection at 215 nm and 310 nm was used.]

286) Geer LC, Hays PA. Letrozole (Femara®) Microgram Journal 2003;1(3-4):190. [Presents analytical data (GC/MS, FTIR, and NMR) for the title compound.]

287) Laasonen M, Harmia-Pulkkinen T, Simard C, Rasanen M, Vuorela H. Development and validation of a near-infrared method for the quantitation of caffeine in intact single tablets. Analytical Chemistry 2003;75(4):754. [Presents a technique for analyzing pharmaceutical products containing primarily caffeine.]

288) Mabrouck MM, ElFatatry HM, Hammad S, Wahbi AAM. Simultaneous determination of loratadine and pseudoephedrine sulfate in pharmaceutical formulation by RPLC and derivative spectrophotometry. Journal of Pharmaceutical and Biomedical Analysis 2003;33(4):597. [Presents an HPLC method (using first derivative spectrophotometric detection) for analysis of the title compounds in pharmaceuticals. Note that loratadine is the active ingredient in prescription Claritin.]

289) Marin A, Garcia E, Garcia A, Barbas C. Validation of a HPLC quantification of acetaminophen, phenylephrine and chlorpheniramine in pharmaceutical formulations: Capsules and sachets. Journal of Pharmaceutical and Biomedical Analysis 2002;29(4):701. [Presents the simultaneous determination and quantitation of the title compounds (and also phenylpropanolamine) in various pharmaceutical formulations.]

290) Metwally FH. Kinetic spectrophotometric methods for the quantitation of triprolidine in bulk and in drug formulations. Journal of Pharmaceutical and Biomedical Analysis 2001;26(2):265.

291) Qi ML, Wang P, Zhou L, Sun Y. Simultaneous determination of four active components in a compound formulation by liquid chromatography. Chromatographia 2003;58(3-4):183. [Describes a rapid and accurate LC method for determination of pseudoephedrine, acetaminophen, dextromethorphan, and diphenhydramine, in a compound formulation.]

292) Qi ML, Wang P, Zhou L, Gu JL, Fu RN. Simultaneous determination of acetaminophen, detromethorphen [sic] and pseudoephedrine hydrochloride in a new drug formulation for cold treatment by HPLC. Chromatographia 2003;57(3-4):139. [Presents a validated method for the referenced analysis, which is completed in less than 10 minutes per run.]

293) Rothchild R. Identification of a heroin diluent: One- and two-dimensional proton and carbon-13 NMR studies of procaine hydrochloride: Computational studies of procaine and its conjugate acid. Spectroscopy Letters 2003;36(1&2):35. [Presents the isolation (from a street sample of heroin) and identification of the title compound, and also presents ab initio molecular modeling calculations.]

294) Suntornsuk L, Pipitharome O, Wilairat P. Simultaneous determination of paracetamol and chlorpheniramine maleate by micellar electrokinetic chromatography. Journal of Pharmaceutical and Biomedical Analysis 2003;33(3):441. [For analysis of cold tablets.]

295) Zhang S, Zhuang YF, Ju HX. Flow-injection chemiluminescence determination of papaverine using cerium(IV)-sulfite system. Analytical Letters 2004;37(1):143. [The method is adequate for determination of papaverine in both pharmaceuticals and biological fluids.]

<u>Theophylline</u>:

296) Huan L, Kan Q, Wang X, Lui X, Bi K. Simultaneous determination of the contents of

five components in compound theophyllini [sic] tablets by statistical-simulation spectrometry. Huaxue Fenxi Jiliang 2002;11(4):11. [Compounds determined included amidopyrine [sic], phenacetine [sic], theophylline, theobromine, and caffeine.]

297) Senturk Z, Erk N, Ozkan SA, Akay C, Cevheroglu S. Determination of theophylline and ephedrine HCl in tablets by ratio-spectra derivative spectrophotometry and LC. Journal of Pharmaceutical and Biomedical Analysis 2002;29(1-2):291.

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):

298) Altria KD, Elder D. Overview of the status and applications of capillary electrophoresis to the analysis of small molecules. Journal of Chromatography A 2003;1023(1):1. [A review of the literature, 1999 - 2002, including forensic applications (not specified in abstract).]

299) Descroix S, Varenne A, Geiser L, Cherkaoui S, Veuthey J-L, Gareil P. Influence of electrolyte nature on the separation selectivity of amphetamines in nonaqueous capillary electrophoresis: Protonation degree versus ion pairing effects. Electrophoresis 2003;24(10):1577. [Presents the title analysis as applied to ecstasy and (unspecified) derivatives.]

300) Hilhorst MJ, Somsen GW, deJong GJ. Capillary electrokinetic separation techniques for profiling of drugs and related products. Electrophoresis 2001;22(12):2542.

301) Issaq HJ. Thirty-five years of capillary electrophoresis: Advances and perspectives. Journal of Liquid Chromatography and Related Technologies. 2002;25(8):1153. [An overview of the development of CE, including forensic applications for analysis of illicit drugs.]

302) Javerfalk-Hoyes E. Development of methods in CE, CE-MS, and MS/MS: Applications in pharmaceutical, biomedical, and forensic sciences. Diss. Abstr. Int., C 2002;63(1):77.

303) Lemos NP, Bortolotti F, Manetto G, Anderson RA, Cittadini F, Tagliaro F. Capillary electrophoresis: A new tool in forensic medicine and science. Science Justice

2001;41(3):203.

304) Schmitt-Kopplin P, Frommberger M. Capillary electrophoresis - mass spectrometry; 15 years of developments and applications. Electrophoresis 2003;24(22-23):3837. [An overview and review.]

305) Sherma J. A field guide to instrumentation: Capillary electrophoresis. Inside Laboratory Management (AOAC International) 2003;7(1):19. [Presents an overview of the technique, and a brief review of recent advances in commercial CE instrumentation.]

306) Tavares MFM, Jager AV, da Silva CL, Moraes EP, Pereira EA, de Lima EC, Fonseca FN, Tonin FG, Micke GA, Santos MR, de Oliveira MAL, de Moraes MdLL, van Kampen MH, Fujiya NM. Applications of capillary electrophoresis to the analysis of compounds of clinical, forensic, cosmetological, environmental, nutritional and pharmaceutical importance. Journal of the Brazilian Chemical Society 2003;14(2):281.

307) Thormann W, Lurie IS, McCord B, Marti U, Cenni B, Malik N. Advances of capillary electrophoresis in clinical and forensic analysis (1999-2000). Electrophoresis 2001;22(19):4216. [A general review article, covering the CE analyses of a wide variety of substrates of forensic interest.]

308) Weinberger R. The evolution of capillary electrophoresis. American Laboratory 2002;34(10):32. [A general overview and review.]

Gas Chromatography (and Tandem GC Techniques):

309) Chang W-T, Lin DL, Liu RH. Isotopic analogs as internal standards for quantitative analyses by GC/MS - Evaluation of cross-contribution to ions designated for the analyte and the isotopic internal standard. Forensic Science International 2001;121(3):174. [Focus is on drugs and metabolites in biological matrices.]

310) Dallabetta-Keller T. Trace analysis by GC/MS using pulsed splitless injections. Proceedings - NOBCChE 2001;28:4. [A pressure pulsed injection technique for GC/MS allows for enhanced detection of trace level controlled substances.]

311) Gorecki T, Harynuk J, Panic O. Comprehensive two-dimensional gas chromatography (GC x GC). New Horizons and Challenges in Environmental Analysis and Monitoring [Workshop], Gdansk, Poland, Aug. 18-29, 2003, pps 61-83. [Presented examples include (unspecified) forensic samples.]

312) Matsuda K, Nakatoh S, Minatogawa Y, Suzuki K, Kimura H, Yamamoto S, Kohama A, Tohyama K. Development of a GC/MS library for analyzing pesticides and drugs. Rinsho Byori 2003;51(10):63871009-B963. [Presents the development of a library with 20 pesticides and herbicides, and 57 drugs (not specified in the abstract).]

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

313) 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.]

314) De Boeck G, Wood M, Samyn N. Recent applications of LC-MS in forensic science. LC-GC 2002;15(11):19. [An overview of the use of LC/MS in forensic science (illicit drugs are not specifically covered).]

315) Flanagan RJ, Harvey EJ, Spencer EP. HPLC of basic drugs on microparticulate strong cation-exchange materials - A review. Forensic Science International 2001;121(1-2):97.

316) Nakashima K. Determination of stimulants by HPLC. Japanese Journal of Forensic Toxicology 2003;21(3):197. [A review of the use of HPLC and common detection systems.]

317) Perrin C, Matthijs N, Mangelings D, GranierLoyaux C, Maftouh M, Massart DL, VanderHeyden Y. Screening approach for chiral separation of pharmaceuticals; Part II. Reversed-phase liquid chromatography. Journal of Chromatography A 2002;966(1-2):119. [A screening strategy for the rapid separation of drug enantiomers by reversed-phase liquid chromatography is presented. Results for 37 diverse chiral pharmaceuticals are presented (the specific products were not detailed in the abstract).]

318) Perrin C, Vu VA, Matthijs N, Maftouh M, MassartDL, VanderHeyden Y. Screening approach for chiral separation of pharmaceuticals. Part 1. Normal-phase liquid chromatography. Journal of Chromatography A 2002;947(1):69.

319) Sagmuller B, Schwarze B, Brehm G, Trachta G, Schneider S. Identification of illicit drugs by a combination of liquid chromatography and surface-enhanced Raman scattering spectroscopy. Journal of Molecular Structure 2003;661-662:279. [Presents a novel HPLC-SERS technique for analysis of illicit drugs (not specified in abstract).]

320) Sherma J. High-performance liquid chromatography/mass spectrometry analysis of botanical medicines and dietary supplements: A review. J Assoc Off Anal Chem 2003;86(5):873. [Includes discussion of related techniques.]

321) Sychev KS, Sychev SN. Application of universal mobile phases in high-effective liquid chromatography for analysis of the objects of food industry, criminology and pharmaceutical chemistry. Zavodskaya Laboratoriya, Diagnostika Materialov 2003;69(9):8. [Various diethylammonium based run buffers are examined for RP-HPLC.]

322) Xiang Y, Wu N, Lippert JA, Lee ML. Separation of chiral pharmaceuticals using ultrahigh pressure liquid chromatography. Chromatographia 2002;55(7-8):399.

Inductive Coupled Plasma- Mass Spectrometry (ICP-MS):

323) Almirall JR, Furton KG. New approaches to forensic chemical analysis. Proceedings, 16th International Symposium on the Forensic Sciences, Canberra 2002(16):(No pps given). [An overview of SPME and ICP/MS methodologies.]

324) Cottingham K. ICPMS: It's elemental. Analytical Chemistry 2004;76(1):35A. [An overview of the title topic.]

325) Smith WD. Controversy over forensic ICPMS method. Analytical Chemistry 2002;74(15):411A.

Infrared and Raman Spectroscopy:

326) Bartick E. Forensic analysis by Raman spectroscopy: An emerging technology. Proceedings of the 16th Meeting of the International Association of Forensic Sciences, Montpellier, France, September 2-7, 2002, pps 45-50. [A general introduction and review of Raman for forensic analysis.]

327) Enculescu AL, Steiginga JR. Raman spectroscopy - A powerful tool for non-routine analysis of pharmaceuticals. American Pharmaceutical Review 2002;5(1):81. [A minor review of the title technique, with an emphasis on non-routine pharmaceutical samples.]

328) Ishihara A, Nakamura H. Qualitative and quantitative analysis of principal ingredients in tablets by near-infrared spectroscopy. Bunseki Kagaku 2002;51(10):899. [Presents a study of NIRS for qualitative and quantitative analyses of the principal ingredients in

tablets (for forensic purposes).]

329) Jarman JL, Seerley SI, Todebush RA, de Haseth JA. Semiautomated depositor for infrared microspectrometry. Applied Spectroscopy 2003;57(9):1078. [Presents a novel method for depositing minute samples for IR microspectrometry (the authors suggest applicability to forensic analyses).]

330) Ryder AG. Classification of narcotics in solid mixtures using principal component analysis and Raman spectroscopy. Journal of Forensic Sciences 2002;47(2):275.

Ion Spectroscopy:

331) Aristarkhova AA, Volkov SS, Dmitrevskii YE, Kitaeva TI, Ognev VI, Plotkin DM, Timashev MY. Characteristics of ion spectroscopy use in forensic science [sic]. Vzaimodeistvie Ionov s Poverkhnost'yu Materialy Mezhdunarodnoi Konferentsii, 15th, Zvenigorod, Russian Federation, Aug. 27-31, 2001 2001;1:335. [A review on the use of ion spectroscopic methods in forensic science.]

332) Derringer B, Leigh T. Solving problems in ion mobility measurements of forensic samples with thermal desorption and dynamic modeling. Dissertations Abstracts International B 2003;64(4):1715.

Mass Spectrometry:

333) Aebi B, Bernhard W. Advances in the use of mass spectral libraries for forensic toxicology. Journal of Analytical Toxicology 2002;26(3):149.

334) Libong D, Pirnay S, Bruneau C, Rogalewicz F, Ricordel I, Bouchonnet S. Adsorption-desorption effects in ion trap mass spectrometry using in situ ionization. Journal of Chromatography A 2003;1010(1):123. [Quadrupole mass spectrometers were compared for the GC/MS analyses of diazepam, alprazolam, triazolam, LSD, trimethylsilylated LSD, and trimethylsilylated buprenorphine.]

335) Yinon J. Advances in forensic applications of mass spectrometry. CRC Press LLC:Boca Raton, FL, 2004.

Microchip Technology:

336) Anonymous. Forensic sample analysis on a microchip. Analytical Chemistry

2004;76(7):117A.

337) Belder D, Deege A, Maass M, Ludwig M. Design and performance of a microchip electrophoresis instrument with sensitive variable-wavelength fluorescence detection. Electrophoresis 2002;23(14):2355. [A modular instrument for high-speed microchip electrophoresis equipped with a sensitive variable-wavelength fluorescence detection system was developed and evaluated using fluorescein isothiocyanate (FITC)-labelled amines, including amphetamine.]

338) Felton MJ. Lab on a chip: Poised on the brink. Analytical Chemistry 2003;75(23):505A. [A review of the topic, and an overview of the available instrumentation in the field.]

339) Harris CM. Shrinking the LC landscape. Analytical Chemistry 2003;75(3):65A. [A conversational overview of recent developments in chip-based technologies.]

340) Schwarz MA, Hauser PC. Rapid chiral on-chip separation with simplified amperometric detection. Journal of Chromatography A 2001;928(2):225.

341) Verpoorte E. Microfluidic chips for clinical and forensic analysis. Electrophoresis 2002;23(5):677.

Nuclear Magnetic Resonance Spectroscopy:

342) Tishmack PA, Bugay DE, Byrn SR. Solid-state nuclear magnetic resonance spectroscopy - pharmaceutical applications. Journal of Pharmaceutical Sciences 2003;92(3):441. [A minor review of the title topic, focusing on solid pharmaceutical drug formulations.]

Osmolality:

343) Wesley JF. Osmolality - A novel and sensitive tool for detection of tampering of adulterated with ethanol, gamma-butyrolactone, and 1,4-butanediol, and for detection of dilution-tampered demerol syringes. Microgram Journal 2003;1(1-2):8. [Presents the title technique and various real-world applications.]

Solid Phase Micro-Extraction:

344) Liu B, Chang Y. Solid-phase microextraction and its application in the analysis of drugs of abuse. Zhongguo Yaowu Yilaixing Zazhi 2002;11(4):313. [A review of the title

topic.]

345) Vas G, Vekey K. Solid-phase microextraction: A poweful sample preparation tool prior to mass spectrometric analysis. Journal of Mass Spectrometry 2004;39(3):233. [An overview and review of SPME.]

Thin Layer Chromatography:

346) Azoury M, Zelkowicz A, Goren Z, Almog J. Evaluation of ninhydrin analogues and other electron-deficient compounds as spray reagents for drugs on thin layer chromatograms. Microgram Journal 2003;1(1-2):23.

347) Spangenberg B, Ahrens B, Klein KF. TLC analysis in forensic sciences using a diode array detector. Chromatographia 2001;53(Part 2, Suppl S):S438.

348) Spangenberg B, Ahrens B, Klein K-F. Diode-array HPTLC in forensic sciences. GTFCh Symposium: Toxikologische Aspekte der Sterbehilfe - Neue Drogen: Chemische, Analytische und Toxikologische Aspekte, Beitraege zum Symposium der Gesellschaft fuer Toxikologische und Forensische Chemie, 12th, Mosbach, Germany, April 26-28, 2001, pps 356-61, 2001. [The primary focus is forensic analysis of biological matrices.]

X-Ray based Techniques:

349) Muratsu S. An application of synchrotron radiation to the analysis of forensic samples, mainly drugs of abuse. Bunseki Kagaku 2003;52(11):1061.

350) Rendle DF. Use of X-rays in the United Kingdom Forensic Science Service. Advances in X-ray Analysis 2003;46:17. [Presents four case studies, including the use of XRD in the analysis of "street drug seizures" (not specified in the abstract)]

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:

351) Allen WC. Method of analyzing the constituents of air extracted from the interior of a piece of luggage. U.S. Pat. Appl. Publ. US 20040035185 A1 26 Feb 2004, 17 pp. CLASS: ICM: G01N033-22. NCL: 073031020; 073863810. APPLICATION: US 2002-224688 21 Aug 2002. [The primary application is for explosives, but the technique can be applied to drugs.]

352) Bannister WW, Chen C-C, Curby WA, Chen EB, Damour PL, Morales A. Thermal analysis for detection and identification of explosives and other controlled substances. U.S. US 6406918 B1 18 June 2002. [Includes identification of illicit drugs (i.e., in addition to explosives).]

353) Barzilov AP, Womble PC, Vourvopoulos G. NELIS - A neutron inspection system for detection of illicit drugs. AIP Conference Proceedings 2003;680:939. [For inspection of cargo pallets.]

354) Brestel M, Gft M, Sharon U. Controlled substance detection and identification system. U.S. Pat. Appl. Publ. US 20040051867 A1 18 Mar 2004. CLASS: ICM: G01J003-44. ICS: G01J003-30. NCL: 356318000; 356301000. APPLICATION: US 2003-428398 2 May 2003. PRIORITY: IL 2002-151745 12 Sep 2002. [The controlled substances not specified in abstract.]

355) Buryakov IA, Kolomiets YN. Rapid determination of explosives and narcotics using a

multicapillary-column gas chromatograph and an ion-mobility spectrometer. Journal of Analytical Chemistry - Russia (translation of Zhurnal Analiticheskoi Khimii) 2003;58(10):944. [The title technique was applied to detection of heroin, cocaine HCl and cocaine base (crack).]

356) Buryakov IA. Express analysis of explosives, chemical warfare agents, and drugs with multicapillary column gas chromatography and ion mobility increment spectrometry. Journal of Chromatography B - Analytical Technologies in the Biomedical and Life Sciences 2004;800(1-2):75. [The title technique was applied to analysis of heroin, cocaine hydrochloride, and cocaine base.]

357) Cottingham K. Ion mobility spectrometry rediscovered. Analytical Chemistry 2003;75(19):435A. [A mini-review of IMS, focusing on potential applications in proteomics. Includes an overview of current instrumentation.]

358) Halamek J, Makower A, Skladal P, Scheller FW. Highly sensitive detection of cocaine using a piezoelectric immunosensor. Biosensors and Bioelectronics 2002;17(11-12):1045. [Presents a rugged, highly sensitive competitive immunoassay-based piezoelectric sensor for cocaine.]

359) Hallowell SF. Screening people for illicit substances: A survey of current portal technology. Talanta 2001;54(3):447.

360) Harris CM. GC to Go. Analytical Chemistry 2002;74(21):585A. [A minor review of the current status of portable GC and GC/MS instrumentation.]

361) Harris CM. Raman on the run. Analytical Chemistry 2003;75(3):75A. [A conversational overview of recent developments in portable Raman, including a comparative listing of five commercially available instruments.]

362) Kiraly B, Sanami T, Doczi R, Csikai J. Detection of explosives and illicit drugs using neutrons. Nuclear Instruments & Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms 2003;213:452. [Presents a Thermal Neutron Activation technique for the title analyses. The "illicit drugs" were not specified in the abstract.]

363) Kuo C, Nagarajan R, Bannister WW, Loder RA, Furry JW, Chen C-C. Detection of concealed explosives and drugs by thermal analysis and thermal profiles of samples with microsensors. PCT Int. Appl. WO 2004027386 A2 1 Apr 2004. CLASS: ICM: G01N.

APPLICATION: WO 2003-US29741 22 Sep 2003. PRIORITY: US 2002-PV412619 20 Sep 2002. [Presents the title patent (the explosives and drugs were not specified in the abstract).]

364) Litman MA. Rapid-acting drug analysis system. U.S. Pat. Appl. Publ. US 2003 224,474 (Cl. 435-28; C12Q1/28), 4 Dec US Appl. PV 383,840, 30 May 2002. [Appears to be a methodology for detecting date-rape type drugs in liquids.]

365) Nguyen DH, Berry S, Geblewicz JP, Couture G, Huynh P. Chemiluminescent detection of explosives, narcotics, and other chemical substances. U.S. Pat. Appl. Publ. US 20040053421 A1 18 Mar 2004. CLASS: ICM: G01N021-76. NCL: 436172000; 436164000; 436117000; 436155000; 436159000; 422052000; 422078000; 422080000; 422082050; 422082080. APPLICATION: US 2002-241407 12 Sep 2002. [The narcotics not specified in abstract.]

366) Ochoa ML, Harrington PB. Detection of methamphetamine in the presence of nicotine using in situ chemical derivatization and ion mobility spectrometry. Analytical Chemistry 2004;76(4):985.

367) Smith WD. SAW chip sniffs out cocaine. Analytical Chemistry 2003;75(23):492A. [Presents an overview of the use of surface acoustic wave based devices for detecting cocaine vapor or particulates.]

368) Stojanovic MN, Landry DW. Aptamer-based colorimetric probe for cocaine. Journal of the American Chemical Society 2002;124(33):9678.

369) Stubbs DD, Lee S-H, Hunt WD. Cocaine detection using surface acoustic wave immunoassay sensors. Proceedings of the IEEE International Frequency Control Symposium & PDA Exhibition, New Orleans, LA, United States, May 29-31, 2002, 289-298. [Presents a study of real-time, vapor-phase detection of cocaine using a specialized SAW device.]

370) Stubbs DD, Lee SH, Hunt WD. Investigation of cocaine plumes using surface acoustic wave immunoassay sensors. Analytical Chemistry 2003;75(22):6231. [Presents the results of a series of experiments demonstrating real-time vapor phase detection of cocaine in the gas phase with SAW-based instruments.]

IX) Miscellaneous

References:

Analytical Artifacts:

371) Varshney K-M. HPTLC study of the stability of heroin in methanol. Journal of Planar Chromatography 2002;15(1):46. [Presents the results of a degradation study of heroin in methanol (at room temperature). The results indicate degradation is measurable on Day 2, and is complete in around 38 weeks.]

Chemometrics:

372) Praisler M, Van Bocxlaer J, De Leenheer A, Massart DL. Chemometric detection of thermally degraded samples in the analysis of drugs of abuse with gas chromatography-Fourier-transform infrared spectroscopy. Journal of Chromatography A 2002;962(1-2):161. [For the identification of the reference standard peak in cases where the GC-FTIR analysis gives multiple peaks.]

Cocaine:

373) Brachet A, Rudaz S, Mateus L, Christen P, Veuthey J-L. Optimisation [sic] of accelerated solvent extraction of cocaine and benzoylecgonine from coca leaves. Journal of Separation Science 2001;24(10-11):865. [A variety of extraction parameters were varied to achieve the optimal results. Analysis was conducted by GC/FID and CE with UV detection.]

374) Tanaka S, Lio R, Chinaka S, Takayama N, Hayakawa K. Analysis of reaction products of cocaine and hydrogen peroxide by high performance liquid chromatography/mass spectrometry. Biomedical Chromatography 2002;16(6):390. [Various hydroxy and dihydroxy cocaines were identified.]

Counterfeit Drugs:

375) Rudolf PM, Bernstein IBG. Counterfeit drugs. New England Journal of Medicine 2004;350:1384.

376) Scafi SHF, Pasquini C. Identification of counterfeit drugs using near-infrared spectroscopy. Analyst 2001;126(12):2218.

Dragon's Blood:

377) Edwards HGM, de Oliveira LFC, Prendergast HDV. Raman spectroscopic analysis of Dragon's Blood resins - Basis for distinguishing between Dracaena (Convallariaceae), Daemonorops (Palmae), and Croton (Euphorbiaceae). Analyst 2004;129(2):134.

378) Hu Y, Ning Z, Liu D. Determination of pterostilbene in Dragon's Blood by RP-HPLC. Yaowu Fenxi Zazhi 2002;22(6):428.

379) Hu Y, Zhang J, Liu C-h, Deng C. Difference of Dragon's Blood from different extract processing. Zhongcaoyao 2002;33(8):697. [Analysis by TLC, UV, and HPLC.]

380) Hu Y, Li L, Han H. HPLC determination of loureirin A and B in Dragon's Blood. Yaowu Fenxi Zazhi 2003;23(1):7. [Presents an HPLC/UV method for detection of the title compounds.]

Drugs on Currency:

381) Jenkins AJ. Drug contamination of US paper currency. Forensic Science International 2001;121(3):189. [Includes cocaine, heroin, 6-monoacetylmorphine, morphine, codeine, methamphetamine, amphetamine, and phencyclidine, by GC/MS.]

382) Jourdan TH, Malak K, Cavett V, Eckenrode BA. Continuing exploration of cocaine contamination of U.S. currency. Proceedings of the American Academy of Forensic Sciences 2003;9:33. [An overview of this issue.]

Heroin:

383) Brazier JS, Morris TE, Duerden BI. Heat and acid tolerance of Clostridium novyi Type A spores and their survival prior to preparation of heroin for injection. Anaerobe 2003;9(3):141. [Presents the title study. This study was in followup to the outbreak of clostridium illnesses and deaths in the United Kingdom as a result of the use of contaminated heroin. The results indicate that typical heroin preparation procedures (by abusers) are not adequate to kill the spores.]

Khat:

384) Al-Motarreb A, Baker K, Broadley KJ. Khat: Pharmaceutical and medical aspects and its social use in Yemen. Phytotherapy Research 2002;16:403. [An overview of the

history, cultivation, and constituents of khat; however, the primary focus is pharmacological.]

Methamphetamine:

385) Yudko E, Hall HV, McPherson SB, Eds. Methamphetamine use: Clinical and forensic aspects. CRC Press LLC: Boca Raton, Fla.) 2003.

Qualitative Tests:

386) Deakin AL. A study of acids used for the acidified cobalt thiocyanate test for cocaine base. Microgram Journal 2003;1(1-2):40. [A study of the use of substitute acids for concentrated hydrochloric acid in the referenced test, with recommendations.]

387) Friedman AJ. Method for identification of flunitrazepam. U.S. US 6713306 B1 30 Mar 2004. CLASS: ICM: G01N033-00. NCL: 436096000; 436106000; 436164000; 436150000; 436901000. APPLICATION: US 2001-946225 5 Sep 2001. [Presents a field method for detection of flunitrazepam in a sample (few details provided in the abstract).]

388) Glattstein O, Glattstein B. A method for the detection of compounds comprising methylenedioxyphenyl and testing kit for the same. PCT Int. Appl. WO 2003052426 A1 26 Jun 2003, 22 pp. CLASS: ICM: G01N033-94. APPLICATION: WO 2002-IL1024 19 Dec 2002. PRIORITY: IL 2001-147185 19 Dec 2001.

389) Makarov SA, Simonov EA, Makarov VG, Kozlov AS. Method for determination of narcotic, psychotropic and offensive substances of plant and synthetic origin. Russ. RU 2,205,385 (Cl. G01N21/78) 27 May 2003, Appl. 2,002,103,845, 18 Feb 2002. [Appears to present a narcotics test kit (abstract is not clear).]

390) Murray RA, Doering PL, Merves ML, McCusker RR, Chronister CW, Goldberger BA. Putting an ecstasy test kit to the test. Proceedings of the American Academy of Forensic Sciences 2003;9:307. [Presents a study of the DanceSafe ecstasy testing kit.]

391) Murray RA, Doering PL, Boothby LA, Merves ML, McCuster RR, Chronister CW, Goldberger BA. Putting an Ecstasy test kit to the test: Harm reduction or harm induction? Pharmacotherapy 2003;23(10). [Presents a critical analysis and evaluation of the DanceSafe Complete Adulterant Screening Kit for Ecstasy®.]

392) Zhang H, Tang J, Liu Y, Shao W, Fan X, Qin Y. Method and test paper for semi-quantitative detection of drugs/medicine by color band-degressive immunological chromatography. Faming Zhuanli Shenqing Gongkai Shuomingshu CN 1,381,729 (Cl. G01N33/558), 27 Nov 2002, Appl. 2,002,114,110, 30 Apr 2002. [The title methodology was applied to over 24 drugs.]

Quality Assurance:

393) Chang W-T, Chiu J, Liang Y-H, Liu RH. Characteristics of calibration curve resulting from the use of an H2-analog of the analyte as the internal standard - Methamphetamine example. Proceedings of the American Academy of Forensic Sciences 2002;8:275. [Presents a discussion of the causes of deviations in the referenced calibration curve.]

394) Chang W-T, Smith J, Liu RH. Isotopic analogs as internal standards for quantitative GC/MS analysis - Molecular abundance and retention time differences as interference factors. Journal of Forensic Sciences 2002;47(4):873. [Isotopic analogues of five barbiturates were evaluated as internal standards.]

395) Coyle HM, Neylon S, Ladd C, Palmbach T, Lee HC. Validation of the AFLP technique for the individualization of marijuana (C. sativa L.) samples. Proceedings of the American Academy of Forensic Sciences 2002;8:68. [Presents the results of the referenced validation study.]

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