The 2016 “Research on Drug Evidence” Report

[From the 18th ICPO / INTERPOL Forensic Science Symposium]

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ABSTRACT: A reprint of the 2016 “Research on Drug Evidence” Report (a review) is provided.

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

Important Information:

Presented at the 18th ICPO / INTERPOL Forensic Science Symposium, Lyon, France, October 11 - 13, 2016.

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.

The "General Overview" (Talking Paper) was removed from this reprint (Editor's discretion).

This reprint is derived from the original electronic document, and is not an image of the best available hard copy (as was utilized for the 1995 and 1998 reports). For this reason, the pagination in the Proceedings is not retained in this reprint, some minor reformatting was done to eliminate deadspace, and all widow and orphan lines were left as is.

Research on Drug Evidence

July 1, 2013 - June 30, 2016

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Eighteenth ICPO - INTERPOL
Forensic Sciences Symposium
October 2016

Lyon, France

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Preface Notes:

1. With the exception of synthetic cannabinoids and cannabimimetics, all references are subdivided by individual drug, drug group/class, or general topic, then chronologically (year only) within each subsection, then alphabetically by first author within each year. Synthetic cannabinoids and cannabimimetics are in a separate category (1.D), and are subdivided as individual compounds, groups of compounds, and finally as groups with other drugs.

2. Many citations included in this report are dated prior to July 1, 2013, because they had not yet been abstracted prior to the 2013 report. In addition, many of the references in this report are cited as "Ahead of Print;" because their actual publication citation was never subsequently published in Chemical Abstracts. For this reason, the year listed with "Ahead of Print" may not reflect the actual year of publication; however, the rest of the citation will remain the same, allowing the full citation to be easily found by Internet searching.

3. All citations are formatted in accordance with *Uniform Requirements for Manuscripts Submitted to Biomedical Journals*, except that journal names are not abbreviated.

4. In contrast to recent reports, no restricted articles are cited in this report.

5. A small number of citations are bolded, reflecting topics judged to be of notable importance. **[Bolding removed at the Editor's Discretion]**

1. Routine and Improved Analyses of Abused Substances

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 "designer drugs."

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 fields of analytical chemistry and toxicology, provide new and/or improved methods of analysis for abused substances. 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.

1.A - Individual Compounds or Substances
1.B - Individual Natural Products Containing Abused Substances
1.C - Common Groups or Classes of Compounds or Substances
1.D - Synthetic Cannabinoids and Cannabimimetics
1.E - Mixed or Unrelated Individual (Named) Compounds or Substances

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1.A - Individual Compounds or Substances (except individual synthetic cannabinoids and cannabimimetics, which are compiled under 1.D)

Alprazolam: 2014 by UV/Vis after derivatization with DDQ (1); **2015** as a contaminant in "natural waters" by adsorptive cathodic stripping voltammetry (2);

2-Amino-1-(4-bromo-2, 5-dimethoxyphenyl)ethan-1-one (bk-2C-B): 2015 characterization by GC/MS (with and without derivatization with 2,2,2-trichloroethyl chloroformate), LC/HRMS, and NMR (3); synthesis and identification of bk-2C-B by NMR, GC, LC, and HR-MS (4);

5-(2-Aminopropyl)indole (5-IT): 2015 an overview (5);

Amphetamine: 2013 impurity profile of amphetamine produced from APAAN (6); **2014** identification of 4,6-dimethyl-3,5-diphenylpyridin-2-one as a route specific byproduct for amphetamine synthesized by the APAAN to P2P, Leuckart route (7); **2015** determination of relative enantiomer migration order using racemic amphetamine (8); **2016** impurity profiling of P2P-derived amphetamine; identification and characterization of the by-products from the APAAN and alpha-methylstyrene routes to P2P and their respective impurities following

Leuckart reduction (9);

Barbital: 2013 determination by RP-HPLC (10);

Benzphetamine: 2014 production and impurity profiling of benzphetamine HCl (11);

1-Benzylpiperazine (BZP): 2013 a review (social focus, but includes "analytical methodologies for the identification of BZP in forensic settings") (12); **2015** determination of the isotopic makeup of BZP synthesized from 3 different sources by IRMS (13);

4-Bromo-2,5-dimethoxyamphetamine: 2015 by LC-MS/MS (14);

2-(4-Bromo-2,5-dimethoxyphenyl)-N-[(2-methoxyphenyl)methyl]ethanamine (25B-NBOMe): 2015 by HP-TLC (15); a review (16);

Buphedrone (2-(Methylamino)-1-phenylbutan-1-one): 2013 characterization with GC/MS, HPLC-DAD, and LC-MS/MS (17);

Buprenorphine: 2016 abuse and diversion of the buprenorphine transdermal delivery system (18);

Camfetamine (N-Methyl-3-phenyl-norbornan-2-amine): 2014 an overview (19);

Chloral Hydrate: 2015 detection of chloral hydrate adulteration in alcoholic beverages (20);

2-(4-Chloro-2,5-dimethoxyphenyl)-N-[(2-methoxyphenyl)methyl]ethanamine (25C-NBOMe): 2013 characterization by GC-EI-MS (with and without derivatization with TFAA), LC-ESI-QTOF-MS, FTIR, and NMR (21); **2014** an overview (22);

4-Chloromethcathinone (Clephedrone): 2014 characterization by GC/MS, NMR, GC, and CE (23);

Cocaine: 2012 rapid separation and characterization of cocaine and various cutting agents by differential mobility spectrometry-MS (24); optical detection using a highly specific triple-fragment aptamer (25); **2013** by electrochemical determination (26); by GC/FID (27); determination on circulated banknotes by CE with UV detection (28); separation of cocaine and phenyltetrahydroimidazothiazole mixtures (29); profiling of cocaine seized in Naples, Italy, by 1H-NMR (30); analysis by GC/MS, ATR/FTIR, and chemometric methods (31); detection of contamination of Brazilian currency by HPLC/UV (32); detection of hygrine and cuscohygrine as

possible markers (to distinguish coca chewing from cocaine abuse) by GC/MS (33); fluorescent sensing of cocaine based on a structure switching aptamer, gold nanoparticles, and graphene oxide (34); comparative analysis of solvent impurity profiles obtained by HS-GC/MS (35); detection by a fluorescent biosensing system (36); **2014** IMS evaluation of cocaine occupational exposure in forensic laboratories (37); electrochemical detection using disposable sensors (38); determination of levamisole and tetramisole in cocaine by enantioselective HPLC with circular dichroism detection (39); the stability of cocaine and its metabolites in municipal wastewater (presents the case for using metabolite consolidation to monitor cocaine utilization) (40); impurity profiling of cocaine seized by the Brazilian Federal Police in 2009-2012 (41); determination of cocaine, benzoic acid, benzoylecgonine, caffeine, lidocaine, phenacetin, benzocaine, and diltiazem by HPLC/DAD (42); analysis of "crack" by Scotts color testing, TLC, GC/FID, and GC/MS (43); quantification by IR and PLSR (44); detection by microfluidic paper sensors (45); determination of the isomeric truxillines in illicit cocaine via CGC/FID and their use and implication in the determination of cocaine origin and trafficking routes (46); a bio-inspired solid phase extraction sorbent material for cocaine (47); radiographic (CT) features of intracorporeally smuggled (body-carried) liquid cocaine versus solid cocaine (48); determination of cocaine, its metabolites, and its pyrolytic products by LC-MS using a chemometric approach (49); determination by diffuse reflectance measurements in the near IR (50); colorimetric detection with aptamer-gold nanoparticle conjugates coupled to an android-based color analysis (51); qualitative analysis by DESI-MS (52); the evaluation of trace cocaine on banknotes (53); novel optical fibre-based cocaine sensors (54); a study of the inclusion complex between p-sulfonated calix[4]arene with cocaine HCl by fluorescence and 1H NMR (55); **2015** determination of cocaine on Brazilian banknotes (analytical methodology not identified in the abstract) (56); multicriteria FTIR/ATR wavenumber selection to differentiate cocaine base versus HCl (57); an electroanalytical method for the quantification of aminopyrine in cocaine (58); chemical profiling of cocaine seizures in Finland by GC/MS (59); comparison of canine detection of methyl benzoate released from 4 different species of snapdragon versus actual cocaine (60); differentiation of South American crack and domestic (US-produced) crack cocaine via HS-GC/MS (61); the influence of medium and elicitors on the production of cocaine, amino acids, and phytohormones by Erythroxylum coca calli (62); a study of the inclusion behavior of p-sulfonated calix [4,6,8] arene with cocaine HCl by fluorescence and 1H NMR (63); a discussion of levamisole in cocaine preparations (64); quantification of cocaine and adulterants by IR and PLSR (65); determination of cocaine in creek water via SPE with subsequent analyses by either HPLC or GC (66); quantification of cocaine, caffeine, 4-dimethylaminoantipyrine, levamisole, lidocaine, and phenacetin by GC/NPD (67); copper thiocyanato complexes and cocaine (a case of "black cocaine") (68); chemical profiling of cocaine in Brazil from 2010 to 2013, a discussion of the increase in aminopyrine in cocaine (analytical methodology not identified in the abstract) (69); HS-GC-MS analysis of South American commercial solvents to monitor their use in the illicit conversion of cocaine base to HCl (70); profiling cocaine and some

common adulterants by FTIR/ATR (71); a review of nanomaterial-based cocaine aptasensors (72); profiling of cocaine by FTIR/ATR, GC/MS, and HS-GC/MS determination of minor alkaloids and residual solvents (73); ultra-high frequency piezoelectric aptasensor for the label-free detection of cocaine (74); identification of different forms of cocaine and substances used in adulteration using NIR Raman spectroscopy and infrared absorption spectroscopy (75); determination of cocaine, its main metabolites, and its pyrolytic products by HPLC-UV-CAD (76); voltammetric determination of cocaine using carbon screen printed electrodes chemically modified with uranyl Schiff base films (77); optical fibre fluorescent chemical probes for the detection of cocaine (78); **2016** detection and unambiguous identification of traces of cocaine on Euro banknotes using FAPA-MS (79); analysis of cocaine and its adulterants by TLC coupled to paper spray ionization MS (80); fast on-site screening of cocaine with a wearable fingertip sensor based on voltammetry (81); geographically sourcing cocaine's origin by delineation of 19 major coca growing regions in South America (82); determination of cocaine, diltiazem, benzocaine, levamisole, caffeine, phenacetin, lidocaine, and dipyrone by LC/DAD (83); use of a small-molecule-dependent split aptamer assemblyfor detn. of cocaine (84); detection by a fluorescence immunoassay (85); use of a key aptamer structure-switching mechanism for the ultrahigh frequency detection of cocaine (86); the stability of cocaine impurity profiles during 12 months of storage, by GC/MS and HS-GC-MS (87); removal of benzoylecgonine in water matrices by UV254/H2O2 processing using a flow microcapillary film array photoreactor (88); determination of procaine in cocaine by a paper-based device coupling electrochemical sample pretreatment and colorimetric detection (89); polarographic determination of the stability constant of the complex formed between cocaine and cobalt thiocyanate (90); detection by a electrochemical aptasensor (91); a fluorescent aptasensor for cocaine based on a G-quadruplex and ruthenium polypyridyl complex molecular light switch (92);

Clobazam (7-chloro-1-methyl-5-phenyl-1,5-dihydrobenzo[1,4]diazepine-2,4-dione): 2015 the dynamic behavior of clobazam on HPLC chiral stationary phases (93); **2016** spectroscopic and quantum chemical studies of the molecular geometry, frontier molecular orbital, NLO, and NBO analysis of clobazam (94);

Codeine: 2013 detection using a label-free electrochemical biosensor based on a DNA aptamer (95); **2014** a rapid colorimetric method for the detection of codeine sulphate using unmodified gold nanoprobe (96); analysis of codeine phosphate sustained release capsules by HPLC (97); **2015** development of an abuse- and alcohol-resistant formulation of codeine phosphate (98); **2016** photocatalytic degrdn. of codeine by UV-irradiated TiO2 (99);

Deschloroketamine (2-Methylamino-2-phenylcyclohexanone): 2016 characterization of deschloroketamine by GC/MS, LC/HRMS, MS/MS, and NMR (100);

Desomorphine ("Krokodil"): 2014 a review (101); **2015** an overview and review (102); analysis by TLC, UV/Vis, 1H NMR, and FTIR (103);

Diazepam: 2015 differentiation of licit and illicit diazepam tablets by DSC (104); **2016** determination of the compatibility between diazepam and tablet excipients by DSC, thermogravimetry, and IR (105);

3,4-Dichloro-N-[2-(dimethylamino)cyclohexyl]-N-methylbenzamide (U-47700): 2016 the first reported fatality associated with U-47700 (and implications for forensic analysis) (106);

1-(2,3-Dihydro-1H-inden-5-yl)-2-phenyl-2-(pyrrolidin-1-yl)-ethanone ("Indapyrophenidone"): 2015 characterization by GC/MS, LC-HRMS, NMR, and X-ray crystallography (107);

Diltiazem: 2015 analytical characterization of two new related impurities of diltiazem (2-(4-methoxyphenyl)-5-methyl-4-oxo-2,3,4,5-tetrahydrobenzo[b][1,4]thiazepin-3-yl acetate and 2-(4-methoxyphenyl)-4-oxo-5-vinyl-2,3,4,5 -tetrahydrobenzo[b][1,4]thiazepin-3-yl acetate) by HRMS and NMR (108);

1-(3,4-Dimethoxyphenyl)-2-(ethylamino)pentan-1-one (DL-4662): 2015 characterization by NMR, GC/MS, and HPLC (109);

4,4'-Dimethylaminorex (4,4'-DMAR): 2015 chemistry, pharmacology, and toxicology (110); an overview (111);

1,3-Dimethylamylamine (DMAA): 2014 determination by 1H NMR (112); **2015** identification by DART-QTOF-MS (113);

1,3-Dimethylbutylamine (DMBA): 2015 identification in dietary supplements by UHPLC/MS (114);

N,N-Dimethyltryptamine (DMT): 2014 conformational, spectroscopic and nonlinear optical properties (a theoretical study) (115); a review (also presenting the results of a global survey) (116);

Eszopiclone: 2013 determination by UHPLC and HPLC (117);

N-Ethyl-alpha-ethylphenethylamine: 2013 characterization by GC/MS, LC-TOFMS, and 1D- and 2D-NMR (118);

2-(Ethylamino)-1-(4-methylphenyl)-1-pentanone (4-MEAP): 2015 analysis by GC/MS, NMR, and LC/EIS (119);

Ethylone (3,4-Methylenedioxy-N-ethylcathinone): 2015 synthesis and characterization of two conformational polymorphs of ethylone HCl by FTIR, FT-Raman, powder XRD, GC-MS, ESI-MS/MS and NMR (13C CPMAS, 1H, 13C) (120);

Etizolam: 2014 synthesis (121);

Fenethylline: 2016 a review (122);

Fentanyl: 2012 impurity profiling of illicit fentanyl using UHPLC-MS/MS (123); **2015** discussion of a case of abuse via extn. of fentanyl from transdermal patches (124); organic and inorganic impurity profiling of fentanyl produced by 6 different methods, using GC-MS, LC-MS, and ICP-MS (125); **2016** impurity profiling using multivariate statistical analysis of orthogonal mass spectral data (includes GC/MS, LC-MS/MS-TOF, and ICPMS) (126);

Flephedrone: 2015 characterization by 1H, 13C, 15N HMBC, and 19F NMR (127);

Flubromazepam: 2013 characterization by NMR, GC/MS, LC-MS/MS, and LC-QTOF-MS (128);

Flunitrazepam: 2013 electroanalytical sensing using screen-printed graphite electrodes (129); **2014** electroanalytical sensing using electrogenerated chemiluminescence (130); **2015** novel reductive-reductive mode electrochemical detection by HPLC with dual electrode detection (131); **2016** detection in beverages using portable Raman (132);

6-Fluoro-3,4-methylenedioxyamphetamine: 2015 crystal structure (133);

4'-Fluoro-α-pyrrolidinobutyrophenone (4F-PBP): 2015 structural characterization by 1H, 13C, 19F NMR, and MS (134);

Heroin: 2012 a review of crystal water in heroin HCl standard (135); **2013** high resolution impurity profiling by UHPLC (136); determination of heroin, morphine, 6-MAM, codeine, and 6-acetylcodeine drug samples using HPLC with "parallel segmented flow," which enables the simultaneous use of UV-absorbance, tris(2,2'-bipyridine)ruthenium(III) chemiluminescence, and permanganate chemiluminescence (137); **2014** determination of heroin, 6-acetylmorphine, acetylcodeine, morphine, noscapine, papaverine, caffeine, acetaminophen, lactose, lidocaine, mannitol, and piracetam by 1H NMR and 2D DOSY 1H NMR (138); comparison of quantitation

of illicit heroin HCl samples obtained by quantitative NMR versus results obtained by CE (139); an overview of the detection of heroin (140); inorganic impurity profiling and classification of illicit heroin by ICP-MS (141); **2015** acetaminophen, caffeine, diazepam, phenobarbital, and alprazolam in heroin by GC/MS (142); characterization and origin of the 'B' and 'C' compounds in the acid/neutral forensic signatures of heroin (143); classification of illicit heroin by UPLC-Q-TOF analysis of acidic and neutral manufacturing impurities (144); **2016** site-and species-specific hydrolysis rates of heroin to the mono-acetylmorphines (145);

Human Growth Hormone (HGH) (and related substances): 2014 identification of the growth hormone-releasing hormone analogue [Pro1, Val14]-hGHRH in a confiscated product (146); identification and quantification of GHRP-2 by NMR and MS (147); **2015** quantification of HGH by isotope dilution-HPLC/MS (148);

Hydrocodone: 2014 synthesis from thebaine in six steps (149); **2015** wastewater effluent hydrocodone concentrations as an indicator of a drug disposal program success (analytical methodology not identified in the abstract) (150);

Hydromorphone: 2016 two orthorhombic polymorphs of hydromorphone (151);

gamma-Hydroxybutyric Acid (GHB) (also gamma-Butyrolactone (GBL), 1,4-Butanediol (BD), and Tetrahydrofuran (THF)): 2013 a comprehensive study of the worldwide distribution of GBL using internet monitoring, comparison of packaging, and carbon isotopic measurements (152); detection of GHB, GBL, and BD in dietary supplements and foods, by GC/MS (using isotopologues for quantitation) (153); development of a fluorescent sensor for GBL (154); **2014** a review of the relative risks of GHB and GBL (155); development of a fluorescent sensor for GHB (156); **2015** analysis of GBL and 1,4-BD by chemical ionization-ion trap-GC/MS (157); **2016** comparative study of GHB and other derivative compounds (GBL, butyric acid, and succinic acid) by spectroelectrochemistry Raman on platinum surface (158); detection of BD in spiked drinks (analytical methodology not provided in the abstract) (159);

Ibogaine: 2013 determination by GC-MS/MS (160);

2-(4-Iodo-2,5-dimethoxyphenyl)-N-[(2,3-methylenedioxyphenyl)methyl]ethanamine (25I-NBMD): 2013 characterization by LC, ESI-QTOFMS, GC/MS, and MS/MS (161);

Ketamine: 2012 a simple color testing reagent for screening (162); **2013** screening in orange juice by TLC (163); a review of O-chlorophenyl cyclopentyl ketone (the precursor for ketamine) (164); **2014** wearable devices based on ionic liquid-based SPME for the environmental monitoring of ketamine (165); estimation by UV/Vis (166); electroanalytical sensing using

electrogenerated chemiluminescence (167); a review (168);

Lisdexamfetamine Dimesylate: 2012 synthesis and characterization by FT-IR, NMR, ESI-TOF/MS, GC-MS, and HPLC (169);

Lysergic Acid Diethylamide (LSD): 2014 determination by adsorptive stripping voltammetry (170);

Mephedrone (4-Methylmethcathinone): 2013 by SERS with a portable Raman (171); **2014** a study of phase transformations (to minimize transitions between polymorphic forms during storage) (172); use of mephedrone as a exemplar in an interpretative spectroscopy exercise in a second-year bioscience program (173); analysis of purity and cutting agents in street-level samples from South Wales collected between Nov. 2011 and March 2013, by FTIR (4-fluoro-methcathinone and 4-methylethcathinone were also found) (174); structures of mephedrone hydrogen sulfate and its polymorphs under ambient and high pressure conditions (175); **2015** computational studies on molecular structure and interpretation of vibrational spectra, thermo-dynamical and HOMO-LUMO analyses of mephedrone using density functional theory and ab initio methods (176); spectrophotometric determination (177); identification of 1,2,3,5-tetra-methyl-4-(4-methylphenyl)-1H-imidazol-3-ium salt (TMMPI), formed during the synthesis of mephedrone (analysis by GC/MS, LC/MS, NMR, and crystal structure determination (178); **2016** detection via an anthracene molecular probe (by NMR) (179);

Methamphetamine: 2012 analysis of the enantiomeric makeup of methamphetamine in OTC inhalers (also includes a toxicology study) (180); fates of precursors and byproducts in soil from the Leuckardt, Nagai, and dissolving metal reductive syntheses of methamphetamine (181); evaluation of the effects of synthesis conditions on the delta13C, delta15N, and delta2H stable isotope ratio values of methamphetamine (182); **2013** detection of pharmaceutical impurities in methamphetamine by GC/FID and GC/MS (183); rapid quantitation of methamphetamine by FTIR/ATR and Chemometrics (184); impurity profiling by CE using a highly sulfated gamma-cyclodextrin as a chiral selector (includes methamphetamine, amphetamine, ephedrine, pseudoephedrine, norephedrine, and norpseudoephedrine) (185); screening of methamphetamine, pseudoephedrine, and ephedrine by a portable lab-on-a-chip instrument (186); quantitation of airborne methamphetamine by SPME and GC/MS (187); detection in indoor air using dynamic SPME followed by GC/MS (188); elemental profiling of methamphetamine using ICPMS (189); influence of precursor solvent extraction on stable isotope signatures of methamphetamine prepared from OTC pharmaceuticals using the Moscow and hypophosphorous syntheses (190); stable isotope analysis of methamphetamine, to help determine precursors (191); molecular fluorescence spectroscopy of methamphetamine in methanol (192); rapid, nondestructive screening test for methamphetamine in clandestine laboratory liquids by Raman (193); impurity

profiling of methamphetamine synthesized from P2P prepared from phenylacetic acid or its esters (194); terahertz spectra of methamphetamine HCl (195); **2014** differentiation of ephedrine and pseudoephedrine based methamphetamine samples by 2D-HPLC (196); determination of methamphetamine in sewers using a Polar Organic Chemical Integrative Sampler followed by HPLC-MS/MS (197); real time quantitative (Simon) colourimetric test for methamphetamine detection using digital and mobile phone technology (198); a review of methamphetamine profiling (199); use of IRMS for methamphetamine profiling (comparison of ephedrine and pseudoephedrine-based samples to P2P-based samples) (200); use of 10-ethylacridine-2-sulfonyl chloride for detection of methamphetamine (201); **2015** "amine-rich carbon nanodots" as a fluorescence probe for methamphetamine precursors (202); photocatalytic degradation of methamphetamine in wastewater by UV/TiO2 (203); use of methamphetamine impurity profiling for intelligence gathering (204); detection by a fluorescence nanosensor (with comparison with HPLC) (205); identification of trans-N-methyl-4-methyl-5-phenyl-4-penten-2-amine HCl as an impurity in methamphetamine synthesized via reductive amination of P2P made from phenylacetic acid/lead (II) acetate (206); enantiomeric profiling of methamphetamine by LC-MS-MS (207); **2016** determination of the synthetic routes of methamphetamine using GC-MS and multivariate analysis (208); demethylation of methamphetamine by UV treatment at wastewater treatment plants (209); detection of trace methamphetamine by dual-mode plasmonic naked-eye colorimetry and a SERS sensor with a handheld Raman spectrometer (210);

Methaqualone: 2013 simultaneous determination of methaqualone, saccharin, paracetamol, and phenacetin in illicit drug samples by HPLC (211);

Methcathinone: 2012 detection by HPLC (212); **2013** qualitative and quantitative analysis by LC/MS/MS (213); quantitative analysis by GC/MS (214);

Methiopropamine: 2015 indirect electrochemical detection of methiopropamine (MPA) and 2-aminoindane (2-AI) by Raman spectroscopy, presumptive (color) testing, HPLC, and electrochemical analysis (this mixture was referred to as "synthacaine") (215); by selective reagent ionisation-TOF-MS for analysis of a mixture of methiopropamine and benzocaine (also referred to as "synthacaine") (216);

Methoxetamine: 2013 by GC-MS and 1H- and 13C-NMR (217); **2014** a review (218);

2-Methoxydiphenidine (2-MXP): 2015 synthesis and characterization (includes the positional isomers; toxicological focus) (219);

para-Methyl-4-methylaminorex: 2014 an overview of deaths from use (220);

3,4-Methylenedioxy-N-benzyl cathinone (BMDP): 2013 characterization by LC/high res QTOF-MS, EI-MS, IR, and 1D- and 2D- 1H- and 13C-NMR (221);

3,4-Methylenedioxymethamphetamine (MDMA): 2013 enantiomeric purification by batch chromatography with a cyclodextrin chiral selector (222); use of organic and inorganic impurities in MDMA for comparative analyses (223); impurity profiles of MDMA synthesized by different routes or by variations in the same routes, by GC/MS and GCxGC-TOF-MS (224); **2014** the effects of extn. procedure and GC temp. programming on MDMA impurity profiles (225); by voltammetry (226); **2015** analysis by direct laser ablation with TOFMS (227); compression studies (228); impurity profiling of MDMA synthesised from catechol (229); chemiluminescence detection of MDMA in street drug samples (230);

3,4-Methylenedioxy-4-methylaminorex (MDMAR): 2015 synthesis of the cis- and trans-isomers, with characterization by "chromatographic, spectroscopic, mass spectrometry, and crystal structure analysis" (231);

Methylenedioxypyrovalerone (MDPV): 2013 injection of MDPV among needle exchange program participants in Hungary (232); **2014** a review, including sepn. and analysis by TLC, GC/MS, HPLC, and LC/MS (233); analysis by GC/MS and LC/MS (234); a review (235); see also phencyclidine (below) for a related citation;

4-Methylethcathinone (4-MEC): 2013 by GC/MS, HPLC-DAD, and LC-MS/MS (236);

Methylhexaneamine: 2013 by GC/HR-TOFMS with soft ionization (237);

β-Methylphenylethylamine (BMPEA): 2015 by LC-QTOF-MS (238);

4-Methylthioamphetamine (4-MTA): 2012 identification of common impurities found in 4-MTA produced by the reductive amination and nitropropene routes (239); identification and synthesis of by-products found in 4-MTA produced by the Leuckart method (240);

Mianserin (a psychoactive tetracyclic antidepressant): 2012 by TLC, color testing, and UV (241);

Midazolam: 2015 a review of published, validated methods for determination of midazolam in pharmaceuticals (242);

Morphine: 2013 evaluation of stationary phases based on silica hydride, using morphine as the model compound (243); determination in compound liquorice tablets by HPLC with online SPE

(244); **2014** detection using electroactive polymers (245); 271 highly sensitive detection based on molecular imprinting polymers using surface plasmon resonance (246); determination in pharmaceutical samples by kinetic spectrophotometry (247); conformational complexity of morphine and morphinum in the gas phase and in water (a DFT and MP2 study) (248); degradation of morphine in opium poppy processing waste composting (249); **2015** "fingerprinting" using chromatographic purity profiling and multivariate data analysis (250); a study of the stability of morphine sulfate orally disintegrating tablets (analytical methodology not identified in the abstract) (251); a review of sugar derivatives of morphine (252); **2016** a structural and computational study (to determine morphine's mechanism of action as an antioxidant) (253); photostability of 6-MAM and morphine exposed to controlled UV irradiation in water and methanol (254); characterization and origin differentiation of morphine base, HCl, and sulfate (and other unspecified "morphine derivatives") by DSC/TG and FTIR (255); detection using cathodically electropolymerized, molecularly imprinted poly(p-aminostyrene) films (256); determination in pharmaceutical products by on-line SPE and HPLC (257);

Oripavine: 2014 a review of the chemistry of oripavine and its derivatives (258);

Oxycodone: 2013 analysis of oxycodone/acetaminophen tablets by HPLC (259); a study on the effectiveness of reformulated (abuse deterrent) oxycodone tablets (260); **2014** a review (261); the impact of a reformulation of extended-release oxycodone designed to deter abuse in a group of prescription opioid abusers (262); reductions in reported deaths following the introduction of extended-release oxycodone with an abuse-deterrent formulation (263); **2015** impact of the introduction of an abuse-deterrent sustained-release formulation in Australia (264); an overview of the level and methods of tampering with a tamper-resistant formulation (265); **2016** evaluation of the tamper-resistant properties of biphasic immediate-release / extended-release oxycodone/acetaminophen tablets (266);

Phenazepam: 2012 analysis of phenazepam by GC/MS and LC-MS/MS (267);

Phencyclidine (PCP): 2013 false-positive PCP immunoassay caused by MDPV (268);

Phenobarbital: 2014 detection by an electrochemical sensor based on molecular imprinted polymer (269); detection by an electrochemical sensor based on molecular imprinted technique and electropolymerization membrane (270); characterization of the monosolvates between phenobarbital and acetonitrile, nitromethane, dichloromethane, and 1,4-dioxane by single-crystal and powder X-ray diffraction, thermoanal. methods, FTIR, Raman, and solid-state NMR (271); **2015** simultaneous determination of phenobarbital and aspirin by HPLC (272); **2016** a study of polymorphism of phenobarbital by structural, thermal, and VT-Raman spectroscopy (273);

Phenyl Acetyl Carbinol (L-PAC and R-PAC): 2014 isolation/selection of the best yeast culture and its metabolic control for the biotransformation of benzaldehyde to 1-hydroxy-1-phenyl-2-propanone (274); use of substituted benzaldehydes for the manuf. of substituted L-PAC analogs (which were subjected to reductive amination to give the corresponding substituted pseudoephedrine/ephedrine analog, which were then either reduced or oxidized to produce the corresponding methamphetamine or methcathinone analogs) (275); **2015** biosynthesis of R-PAC in [BMIM][PF6]/aqueous biphasic system using Saccharomyces cerevisiae (276);

Phenyl-2-propanone (P2P, Phenylacetone): 2016 a detailed analysis of the impurities formed when P2P is synthesized via an aldol condensation of benzaldehyde and Me Et ketone (MEK), followed by a Baeyer-Villiger reaction, followed by ester hydrolysis (route specific markers for this synthesis include 3-methyl-4-phenyl-3-buten-2-one, 2-methyl-1,5-diphenylpenta-1,4-diene-3-one, 2-(methylamino)-3-methyl-4-phenyl-3-butene, 2-(methylamino)-3-methyl-4-phenylbutane, and 1-(methylamino)-2-methyl-1,5-diphenylpenta-4-ene-3-one) (277);

Pregabalin: 2016 a literature review (278);

Pyrazolam (8-Bromo-1-methyl-6-pyridin-2-yl-4H-[1,2,4]triazolo[4,3-a][1,4]benzo-diazepine): 2013 characterization by GC/MS, LC-MS/MS, LC-QTOFMS, and NMR (also includes a toxicology study) (279);

alpha-Pyrrolidinopentiophenone (alpha-PVP): 2013 thermal degradation during GC/MS analysis (280); **2016** structure by crystallography (281);

Scopolamine: 2013 detection in spiked samples by portable CE with contactless conductivity detection (282);

Sibutramine: 2012 quantitative determination in adulterated herbal slimming formulations by TLC-image analysis and TLC-densitometry (Dragendorff reagent was used for spot detection) (283); **2013** detection of illicit adulteration of botanical food supplements, by color tests, TLC, HPLC-DAD, MS, and NMR (284); **2015** detection and quantitation in herbal medicines by NIR (285);

Testosterone: 2014 stable carbon isotope ratio profiling of illicit preparations (by GC-IRMS) (286); **2016** screening for in aquatic environments by DART-MS (287);

Tianeptine: 2016 identification by "a multi-pronged analysis approach" (not detailed in the abstract) (288);

Tramadol: 2014 a survey of abuse of tramadol in the U.K. (289);

1-(3-(Trifluoromethyl)phenyl)piperazine (TFMPP): 2014 an FTIR, FT-Raman, UV/Vis, and DFT quantum chemical study (290);

Zolpidem: 2014 development of modified-release tablets of zolpidem tartrate (291);

Zopiclone (see also Eszopiclone): 2015 quantitative determination of zopiclone and its impurity by four different spectrophotometric methods (292); quantitative determination of zopiclone and its impurity by HPTLC (293).

1.B - Individual Natural Products Containing Abused Substances (except natural products laced with synthetic cannabinoids and/or cannabimimetics)

Overviews and/or Reviews: 2013 an overview of the hallucinogenic plant and fungal species naturally growing in Mediterranean countries (including Phalaris aquatica, Peganum harmala, Mandragora officinarum, Hyoscyamus niger, Atropa belladonna, Datura stramonium, Cannabis sativa, Psilocybe semilanceata, and Amanita muscaria) (294); **2014** natural products as lead structures for the synthesis of "smart" and "recreational" drugs (295); comprehensive comparison of different MS techniques for the detection, identification, and characterization of bioactive substances in herbal materials, including saponins, alkaloid, tropane alkaloids, lycopodium alkaloids, phenethylisoquinoline alkaloids, benzyltetrahydroisoquinolines, morphine, berberine, dauricine, quinolines, flavonoids, flavones, flavanols, anthocyanidins, etc. (296); a review, covering kava, kratom, Salvia divinorum, bufotenine, glaucine, betel, pituri, lettuce opium, and kanna (297);

Ayahuasca: 2015 quantitative determination of the alkaloids in Tetrapterys mucronata (a plant occasionally used in Ayahuasca preparation) by HPLC-ESIMS/MS (bufotenine, 5-methoxy-N-methyltryptamine, 5-methoxybufotenine, and 2-methyl-6-methoxy-1,2,3,4-tetrahydro-β-carboline were identified) (298); **2016** analysis by DART-HRMS (299);

Betel (*Piper betle* Linn): 2013 an overview of its phytochemistry, pharmacological profile, and therapeutic uses (300);

Coca (Erythroxylum): 2012 identification using DNA analysis (301); **2014** chemosystematic identification of 15 new cocaine-bearing Erythroxylum cultigens grown in Colombia for illicit cocaine production (302); selection and validation of reference genes for quantitative gene

expression studies (303);

Damiana (*Turnera diffusa*): 2013 identification and discrimination of damiana in herbal blends by GCxGC (304);

***Datura stramonium* (Jimson weed, Angel Trumpet): 2013** isolation of (3R,5R,7Z)-3-hydroxy-5-dec-7-enolide, (R)-tuberolactone, daturadiol, monolinoleoyl glycerol, linoleic acid, and lutein from Datura stramonium (analytical methodology not identified in the abstract) (305); a review, including testing methods for Flos daturae (306); **2014** a review of the use of Datura for poisoning (307); **2015** analysis of phytochemical alkaloids in Datura stramonium by GC/MS (308); DNA molecular identification of Datura medicinal plants using ITS2 barcode sequence (309); determination of hyoscyamine and scopolamine in Datura stramonium by HPLC (310); fingerprint analysis of Daturae flos using rapid resolution LC-ESI-MS (311);

Ephedra: 2013 determination of ephedrine and pseudoephedrine in Herba ephedrae from different habitats and species by HPLC (312); a review and overview, covering the past 10 years (313); optimum conditions for extracting ephedrine from Ephedra sinica by response surface methodology (based on HPLC analyses) (314); **2014** correlation between the main alkaloid contents and the powder fractions of pulverized Ephedra sinica (analysis by HPLC) (315); **2015** determination of the total alkaloids content, total phenolics content, and total flavonoids content, and determine their relationship in dry herb of Ephedra major, Ephedra distachya subsp. helvetica, Ephedra monosperma, Ephedra fragilis, Ephedra foeminea, Ephedra alata, Ephedra altissima, and Ephedra foliata, by UHPLC/UV (316); the influence of genetic factors on the ephedrine alkaloid composition ratio in ephedra (317); identification and determination of biogenic amines in Ephedrae herba by RP-HPLC with precolumn derivatization (318);

Hawaiian Baby Woodrose (*Argyreia nervosa*): **2015** determination of its alkaloid composition (319);

Khat (*Catha edulis*): 2012 determination of of cathinone, cathine, and phenylpropanolamine in khat by GC/MS and GC/FID (320); **2013** evaluation of the effect of various drying techniques on the levels of cathinone in khat (321); optimized GC analysis for cathine, phenylpropanolamine, and cathinone in khat following derivatization with MSTFA (322); analysis by CE (323); **2015** isolation of kaempferol, quercetin, and myricetin skeletons from khat, with structural analysis by 1H and 13C NMR, and UV (sugars determined by TLC after acid hydrolysis) (324); use of cation-exchange solid-phase and liquid-liquid extraction for the determination of khat alkaloids by reversed phase HPLC-DAD (325); rapid differentiation of khat using single point and imaging vibrational spectroscopy (326); use of a (-)-norephedrine-based molecularly imprinted polymer for the solid-phase extraction of psychoactive phenylpropylamino alkaloids from khat (327); a

review (328); a review (329);

Kratom (*Mitragynine speciosa*): 2013 by microscopy, TLC, and HPLC (330); by HPLC/DAD (331); **2014** by DART-MS (332); quantification of mitragynine in Kratom by an indirect competitive enzyme-linked immunosorbent assay (333); identification of mitragynine and O-desmethyltramadol in kratom (analytical method not identified in the abstract) (334); comparison of GC/MS, SFC with DAD, and HPLC with MS and DAD for detection of mitragynine and other indole and oxindole alkaloids in kratom (335); **2015** identification and characterization of indole and oxindole alkaloids in kratom using LC-accurate-QTOF-MS (336); a review (337); a review of its phytochemistry (338); detection of mitragynine and its analogs (analytical method not identified in the abstract) (339); a review of the chemistry of mitragyna alkaloids (340); the chemistry of the mitragynines (341); an overview and review (342); an overview of the physicochemical properties of mitragynine (includes UV and HPLC analyses) (343); **2016** monitoring the mis-use of kratom in sports (344); a review (345); extraction of mitragynine from kratom (346);

Marijuana and Hemp (*Cannabis sativa*) and associated Phytocannabinoids: 2012 comparison of bulk and compound-specific δ13C isotope ratio analyses for the discrimination of marijuana samples (347); effects of electrical lighting power and irradiance on indoor-grown marijuana potency and yield (348); of THC in marijuana, by HPLC (349); **2013** effects of cultural conditions on the hemp fibres (350); of marijuana extracts by HPLC/UV following cloud point extraction (351); chemical profiling of different hashish seizures by GC/MS and statistical methodology (7 cannabinoids were profiled; analytical methodology not identified in the abstract) (352); production, characterization, and application of hemp essential oil (353); optimisation and characterisation of marijuana extracts obtained by supercritical fluid extraction, focused ultrasound extraction, and retention time locking GC/MS (354); by laser-ablation-ICPMS - a review, covering many other applications (355); a study of marijuana potency from the 1970s to the 2000s (356); supercritical CO2 extraction of cannabis seed oil (and its fatty acid composition analysis) (357); use of ultrasound to extract flavanoids from cannabis (with analysis by UV) (358); determination of cannabinol in "hemp food" by UHPLC-MS/MS (359); potency survey in the Venice, Italy area from 2010-2012 (360); **2014** identification and quantification of cannabinoids in cannabis by HPLC/MS (361); cold pressing and supercritical CO2 extraction of hemp seed oil (362); simultaneous quantification of THC, THC-Acid-A, CBN, and CBD in seized drugs by HPLC/DAD (363); a surface plasmon resonance-based method for detection and determination of cannabinoids (THC, CBD, and CBN) in hashish, using silver nanoparticles (364); variation in mineral composition in the leaves, bark and core of 5 fibre hemp cultivars (365); comparison of 2 different conventional working electrodes for detection of THC using square-wave voltammetry (366); Bayesian classification criterion for discriminating between drug type (illegal) and fiber type (legal) cannabis at an early stage of the growth (367); analysis of

marijuana samples of varying age by the Duquenois-Levine color test (368); variation in preliminary phytochemical screening of cannabis leaf, stem and root (369); separation of aroma compounds from industrial hemp by supercritical CO2 extraction and on-line fractionation (370); fast fingerprinting of cannabinoid markers by laser desorption ionization using silica plate extraction (371); elucidation of the Duquenois-Levine chromophore (372); the kinetics and thermodynamics of hempseed oil extraction by n-hexane (373); evaluation of fatty acid profile, antioxidant capacity and metabolic content of cannabinoid-free cannabis grown in the Po valley, Italy (374); identification of 5,5-dimethyl-1-vinylbicyclo[2.1.1]hexane as a volatile marker of hashish (375); analytical and phytochemical characterization of the unsaponifiable fraction of cannabis seed oil (376); resolution of co-eluting compounds of cannabis comprehensive 2D-GC/MS with Multivariate Curve Resolution-Alternating Least Squares (377); metals and organic compounds in the biosynthesis of cannabinoids - a chemometric approach to correlating the metal content in the different parts of cannabis with the soils where plants were cultivated (and with their cannabinoids content) (378); synthesis of all 4 stereoisomers of THC (379); understanding cultivar-specificity and soil determinants of the cannabis microbiome (includes descriptions of the endorhiza-, rhizosphere-, and bulk soil-assocd. microbiome of 5 distinct cannabis cultivars) (380); cannabis potency in the Venice area (Italy) (2013 update) (381); extraction of flavonoids from cannabis by ultrasound (and its scavenging activity towards the DPPH radical) (382); **2015** minor oxygenated cannabinoids (9α-hydroxyhexahydrocannabinol, 7-oxo-9α-hydroxyhexahydrocannabinol, 10α-hydroxyhexahydrocannabinol, 10a-Rhydroxy-hexahydrocannabinol, Δ9-THC aldehyde A, 8-oxo-Δ9-THC, 10aα-hydroxy-10-oxo-Δ8-THC, 9α-hydroxy-10-oxo-Δ6a,10a-THC, and 1'S-hydroxycannabinol) from high potency cannabis (structural elucidation was accomplished by 1D and 2D NMR, HRMS, and GC/MS) (383); supercritical CO2 extraction of hemp seed oil (384); ab initio quantum mechanical calculations on THC (385); fatty acid composition, and oxidation stability of the hempseed oil from 4 cannabis cultivars (386); determination of the conformation of THC by linear and nonlinear CD (387); using compact mass spectrometry for detection and quantification of cannabinoids in cannabis (388); potential oil yield, evaluation of elemental profiling methods, including laser-induced breakdown spectroscopy, ICP-MS, LA-ICP-MS, and μXRF for the differentiation of cannabis grown in different nutrient solutions (389); quality analysis of cannabis seed oils extracted by the hot-pressing method, the cold-pressing method, or by an aq. enzymic method (390); analysis of cannabinoids and terpenes in cannabis by HPLC/DAD and GC/FID (391); synthesis of THC and related derivatives via a Diels-Alder route (392); isobaric drug analyses of THC and CBD by DART and hydrogen/deuterium exchange (393); molecular imaging of cannabis leaf tissue with MeV-SIMS (394); analysis of marijuana by LC techniques (a literature survey 1990 - 2015) (395); review of marijuana testing rules in Colorado, methods used for testing, and test results (396); increasing sample throughput of cannabis analyses by using a highly selective stationary phase combined with superficially porous particle technol. for HPLC and LC-MS/MS (includes comparison versus UHPLC) (397); screening of cannabinoids in

industrial-grade hemp using 2D-LC with chemiluminescence detection (398); use of 1H NMR and HPLC/DAD to determine cannabis chemotype, extract profiling, and specification (399); the relationship between cannabinoid content and composition of fatty acids in hempseed oils (400); characterization of the smell of marijuana by SPME with multidimensional GC/MS (401); analysis of residual solvents in cannabis extracts by GC (402); an overview of recent improvements in chromatography for analysis of marijuana (403); determination of the relative percentage distribution of THCA and Δ9-THC in herbal cannabis seized in Austria - impact of different storage temperatures on stability (404); feasibility of facile quantification of cannabinoid content in cannabis to discriminate drug- from fiber-type cannabis in the field (405); cannabinoid dose and label accuracy in marijuana edibles (406); determination of THC, CBD, and CBN by GC/MS (focus on athletic doping) (407); differences in the extraction of THC, THCA, and CBN from cannabis by long-lasting liq. extn. in a Soxhlet app. versus pressurized liq. extn. (408); improving quality control methods for extracting cannabis by flash chromatography (409); determination of selected metals in leaves of cannabis by flame AA (410); simultaneous extraction of total flavonoids and total phenolic compounds from hemp (411); **2016** evolution of 8 cannabinoids and 23 terpenes during the growth of cannabis plants from different chemotypes (412); comparison of new and traditional fiber hemp cultivars (stem, bark, and core yield, and chemical composition) (413); heated headspace SPME of marijuana for chemical testing (414); rapid quantitative chemical analysis of cannabinoids in seized cannabis using heated HS-SPME and GC/MS (415); qual. and quant. detn. of CBDA, CBD, CBN, THC and THC-A in "cannabis-based medicinal exts." by HPLC/UV and HPLC-ESI-QTOF-MS (416); report from a Colorado private laboratory on regional cannabis potency (THC, CBD, CBN, THCA, CBDA, THCV, CBDV, CBG, and CBC) by UHPLC analysis (417); potency trends in confiscated cannabis (includes analytical methods; time frame not indicated in the abstract) (418); changes in cannabis potency (focusing on THC and CBD) over the last 2 decades (1995 - 2014) (419); a discussion of the chem. diversity, biosynthesis, and biol. activity of the various compds. in cannabis, and how these compds. can be used to chem. classify cannabis cultivars (420); analytical testing for the cannabis industry (consumer safety vs. regulatory requirements) - an overview of current protocols for testing for the active phytochem. constituents (i.e., cannabinoids and terpenes), but also for potential contaminants including heavy metals, residual solvents, pesticides, mycotoxins, and microbiol. contaminants (421); use of flash chromatography for rapid extraction of cannabinoids from marijuana edibles (422); analysis of cannabis grown in eastern Oregon for THC, THC-A, CBD, and CBN (edibles, concentrates, and waxes were also tested) (423); comparison of fiber and seed productivity of 14 com. hemp cultivars were tested in 4 contrasting environments (Latvia, the Czech Republic, France, and Italy) (424); the influences of cultivation setting on the lipid distributions, concentrations, and carbon isotope ratios in cannabis (these lipids can currently be used to trace cultivation methods of cannabis and may become a more powerful marker in the future, once the mechanism(s) behind the patterns is uncovered) (425); detection of Δ9-THC and Δ8-THC (and also CBD and CBN) by HPLC/UV

(426); cleanup of marijuana edibles using automated flash column chromatography (427);

Marijuana (Genetic and/or Proteomic Analyses): 2012 investigations into transgenic marijuana (428); **2013** extraction of high quality DNA from seized Moroccan hashish (429); analysis of THCA Synthase gene expression by real-time quantitative PCR (430); chemotype and genotype of cannabinoids in hemp (431); by DNA analysis (432); polymorphism of DNA and accumulation of cannabinoids by cultivated and wild hemp (433); characterization of seeds by DNA analysis (434); **2014** a simple and efficient method for high quality genomic DNA isolation from cannabis containing high amount of polyphenols (435); diversity analysis in cannabis based on large-scale development of expressed sequence tag-derived simple sequence repeat markers (436); application of DNA barcoding in cannabis identification (437); a PCR marker linked to a THCA synthase polymorphism is a reliable tool to discriminate potentially THC-rich plants of cannabis (438); nomenclature proposal and SNPSTR haplotypes for 7 new cannabis STR loci (439); characterization of 15 STR cannabis loci - nomenclature proposal and SNPSTR haplotypes (440); **2015** the phytoremediation potential of hemp - identification and characterization of heavy metals responsive genes (441); genetic structure of 5 dioecious industrial hemp varieties (442); genetic identification of cannabis using chloroplast trnL-F gene (443); genetic resources of cannabis in the gene bank at INF&MP in Poznan (which holds about 150 accessions from various regions of the world) (444); cold acclimation induces distinctive changes in the chromatin state and transcript levels of COR genes in 9 cannabis varieties with contrasting cold acclimation capacities (445); sequence heterogeneity of cannabidiolic- and tetrahydrocannabinolic acid-synthase in cannabis and its relationship with chemical phenotype (446); the genetic structure of marijuana and hemp (447); gene duplication and divergence affecting drug content in cannabis (448); characterisation of cannabinoid composition in a diverse cannabis germplasm collection (449); **2016** proteomic characterization of hempseed (450); the inheritance of chemical phenotype in cannabis (regulation of the propyl-/pentyl cannabinoid ratio, and completion of a genetic model) (451); monitoring metabolite profiles of cannabis trichomes during flowering period using 1H NMR-based metabolomics and real-time PCR (452); use of embryos extracted from individual cannabis seeds for genetic studies and forensic applications (a unique profile for each individual was obtained, and a clear differentiation between hemp and marijuana varieties was observed) (453); identification and characterization of the hemp WRKY transcription factors in response to abiotic stresses (454);

Marijuana - Miscellaneous Topics: 2014 the effects of photoperiod on phenological development and yields of industrial hemp (455); detection of pesticides in seized illegal cannabis plants by UPLC/MS-MS in pos. ESI mode using MRM and GC/MS using scan mode (456); **2015** germination characteristics of hemp seeds under single NaCl treatments of varying concentrations (457); method development towards quantifying marijuana consumption using sewage based drug epidemiology (458); medical marijuana's public health lessons - implications

for retail marijuana in Colorado (459); determination of herbicides paraquat, glyphosate, and aminomethylphosphonic acid in marijuana samples by CE (460); an overview of the occupational hazards for employees working in the state-permitted marijuana industries (461); issues with retail promotion of marijuana edibles (462); method development towards quantifying marijuana consumption using sewage based drug epidemiology (463); a series of editorials (published in Nature) concerning various aspects of state-permitted marijuana (464); an overview of health and safety issues for state-permitted marijuana businesses (465); a review on the ingredients in and safety of "hemp seed food" (466); **2016** the appropriateness of applying ISO/IEC 17025 standards to cannabis testing laboratories (467); quantification of THC-COOH in wastewater from a residential treatment plant as a tracer of cannabis use, using LC-MS/MS (468); oral cannabidiol does not alter the subjective, reinforcing, or cardiovascular effects of smoked cannabis (469); an overview of the changing regulations and rules of the state-permitted cannabis industry (470); the effects of ethephon (a plant growth regulator) on changes in the amt. of many terpenoid compds. in cannabis, including THC, CBD, chlorophyll, carotenoids, α-tocopherol, and pyruvate (471); an overview of the American Herbal Product Assocn.'s (AHPA) industry guidelines on manufg., producing, dispensing, and lab. operation stds. as they apply to state-permitted cannabis (including the American Herbal Pharmacopeia's (AHP) cannabis monograph) (472); an overview on preserving personal cultivation rights while regulating commercial cultivation as agriculture (focusing on the excessive energy, water, and other resources needed for cannabis cultivation) (473); evaluation of three multiresidue methods for the determination of 61 pesticides on marijuana by LC-MS/MS (474); an overview of the establishment of the cannabis subdivision of the American Chemical Society (475); use of "cannavaping" as a means for administering "medical marijuana" (476); antifungal activity of the volatiles of high potency cannabis against Cryptococcus neoformans (477); quantification of THC-COOH in wastewater to assess cannabis consumption in Washington state (478);

[Marijuana ("Synthetic Marijuana") - See "Synthetic Cannabinoids and Cannabimimetics" (Subsection 1.D)]

Mimosa: 2013 characterization and purity of DMT isolated from Mimosa tenuiflora inner barks (479);

Mushrooms (including Psilocybe mushrooms): 2013: simultaneous determination of mushroom toxins by LC-TOF-MS (480); **2014** analysis of mushrooms by Fluorescent Random Amplified Microsatellites (F-RAMS) (15 samples of Amanita rubescens and 22 samples of other hallucinogenic and nonhallucinogenic mushrooms of the genera Amanita and Psilocybe were profiled) (481); **2015** identification of psilocybin, psilocin, baeocystin, norbaeocystin, and aeruginascin in Pholiotina cyanopus by LC/MS (482); genetic identification of hallucinogenic and other poisonous mushrooms (483); **2016** DNA-based taxonomic identification of

basidiospores in hallucinogenic mushrooms in "grow-kits" (including LC-UV quali-/quantitative determination of psilocybin and psilocin) (484);

Opium / Opium Poppy / Poppy Seeds (see also Papaver below, and Opiates in Subsection 1.C): 2013 the effects of potassium, boron, and strontium on poppy cultivation (such enhancements may impact impurity profiling studies based on elemental analysis) (485); **2014** simultaneous detn. of morphine, codeine, thebaine, oripavine, papaverine, and noscapine in poppy straw by 2 HILIC methods (486); a review of cold pressed poppy seed oils (487); unambiguous characterization of analytical markers in 4 opium samples using an ion mobility trace detector-mass spectrometer (488); physicochemical properties of opium marc (a waste product from commercial opium processing) (489); management of opium marc as a hazardous waste (490); results from an effort to detect opium fields from a Hyperion image covering a study area in Southwest Afghanistan (491); **2015** comparative analysis of volatile flavor compounds of poppy seed oil extracted by two different methods via GC/MS (492); analysis of alkaloids in poppy straw by HPLC (493); **2016** analysis of opium poppy by 2D-HPLC (494); analysis of poppy seeds (intended for use as food) that had been adulterated with poppy straw (i.e., containing morphine and codeine) by IRMS (495);

Papaver (other species): 2016 measurement of some benzylisoquinoline alkaloids in Papaver bracteatum (496); developmental accumulation of thebaine and some gene transcripts in different organs of Papaver bracteatum (497);

Papaver (Genetic and/or Proteomic Analyses): 2011 characterization of SSR markers in opium poppies (498); **2014** a review of benzylisoquinoline alkaloid biosynthesis in opium poppy (499); development of genomic simple sequence repeat markers in opium poppy by next-generation sequencing (500); comparative analysis of Papaver somniferum genotypes having contrasting latex and alkaloid profiles (501); transcriptome profiling of alkaloid biosynthesis in elicitor induced opium poppy (502); recessive loci Pps-1 and OM differentially regulate PISTILLATA-1 and APETALA3-1 expression for sepal and petal development in Papaver somniferum (503); variation in fatty acid composition of three Turkish opium poppy lines (504); **2015** regulation of the alkaloid biosynthesis by miRNA in opium poppy (505); comparative study for stability and adaptability through different models in developed high thebaine lines of opium poppy (506); **2016** molecular genetic diversity and association mapping of morphine content and agronomic traits in Turkish opium poppy germplasm (507);

Peyote (and other mescaline-containing cacti): 2013 analysis of "peyote tea" by GC/MS and GC/MS/MS in PCI mode (508); **2014** phytochemical study of Echinopsis peruviana (509);

Plant Materials (Multiple Plants in Single Studies): 2013 identification of plant materials

used as supporting matrices for pharmaceuticals, nutritional supplements, and illicit drugs, by DAD, evaporative light scattering detection, and MS (510); a review of chromatographic herbal fingerprints (the "herbs" and the chromatographic method(s) were not identified in the abstract) (511); isotopic analyses to discriminate between organic and "conventional" plants (512); the effects of 11 elements (Co, Mo, Zn, W, Cr, Cu, B, Fe, V, Mn, Ni plus Ca for second species) on the formation and accumulation of indoles and isoquinolines in seedlings of Catharanthus roseus L. and Papaver somniferum L. (513); analysis of the plant materials used as support matrices, by DNA analysis, GC/MS, and LC/MS (514); an overview and review of the application of 2D-IR for determining the composition, origin, and authenticity of herbal medications (515); **2014** evaluation of mycotoxins, mycobiota, and toxigenic fungi in opium poppy, licorice root, Indian rennet, and others (516); the study of elemental profile of some important medicinal plants by Flame AA (the study included Papaver somniferum) (517); comparison of plant DNA extraction kits for plants identification in forensic botany (the plant species were not identified in the abstract) (518); determination of metabolites in finely powdered plant material by Direct Laser Desorption Ionization MS (519); chemotaxonomical classification of the Solanaceae Atropa belladonna, Datura stramonium, Hyoscyamus niger, Solanum dulcamara, and Duboisia by FTIR/ATR in combination with cluster anal. (520); use of hyperspectral data for detection of cannabis and poppy sites, including those mixed with masking vegetation (521); **2015** transcriptome profiling of Catha edulis and Ephedra sinica identifies genes potentially involved in amphetamine-type alkaloid biosynthesis (522); phytoaccumulation of heavy metals in natural vegetation, including cannabis (523); application of chemometrics for identification of psychoactive plants (Salvia divinorum, Mitragyna speciosa, Psychotria viridis, and Calea zacatechichi) using GC/MS, AAS, and ICP/MS (524); the chemical properties of cold-pressed vegetable oils from seeds of hemp (Cannabis sativa L.), blue poppy (Papaver somniferum L.), and several other plants (525); biosynthesis of amphetamine-like alkaloids in Catha edulis and Ephedra spp. (526); profile of toxic metals in 12 different plant materials, including marijuana, by AA (527); use of EILC/MS with supersonic molecular beams for analysis, including cannabis (528); **2016** determination of Mn, Ni, Rb, and Sr in powdered stimulant plants (ginseng, guarana, and others) using high-resolution continuum source AA followed by chemometric classification (529); phytochemical profiling of plants using GC/MS (including cannabis) (530); use of high-throughput DART-HR-TOFMS to screen plant-based drugs of abuse for psychotropic alkaloids and adulterants (plants not identified in the abstract) (531); analysis of Datura spp. seeds, kratom powder, kava powder, Salvia divinorum leaves, Kanna crushed leaf material, Mimosa hostilis, Banasteriopsis caapi, and Morning Glory seeds by DART-HRMS (532);

***Psychotria viridis* (and related species): 2015** examination of Psychotria viridis (DMT was identified by TLC and HPLC) (533); **2016** structural characterization of dimeric indole alkaloids (brachybotryne, its N-oxide deriv., along with bufotenine) from Psychotria brachybotrya by NMR spectroscopy and theoretical calculations (534);

***Salvia divinorum*: 2013** differentiation of Salvia divinorum from marijuana and tobacco by DNA analysis (535); **2014** quantitative determination of salvinorin A in Salvia divinorum (analytical methodology not identified in the abstract) (536); analysis of "legal high" products containing Salvia divinorum for Salvinorins A, B, C, and D (analytical methodology not identified in the abstract) (537); **2015** determination of salvinorin A in commercial products available in Mexico, using HPLC (538); **2016** an overview of the chem. and pharmacol. of Salvia divinorum and salvinorin A (539).

1.C - Common Groups or Classes of Compounds or Substances (except Synthetic Cannabinoids and Cannabimimetics)

(2-Aminopropyl)indoles: 2013 2-, 3-, 4-, 5-, 6- and 7-(2-aminopropyl)indole - analyses by GC/MS and LC/MS (540);

Amphetamine-Type Stimulants (ATSs) and Related Phenethylamines (PEAs): 2011 impurity profiling of various ATSs by physical characterization, qualitative and quantitative analyses, and identification of adulterants, byproducts, and precursors, using GC, GC/MS, and cluster analyses (541); **2012** analysis of 2-, 3-, and 4-methylmethamphetamine and 2-, 3-, and 4-methylamphetamine, by GC/MS and GC/IRD (542); analysis of methamphetamine, amphetamine, and ecstasy by insideneedle adsorption trap based on molecularly imprinted polymer followed by GC/FID (543); **2013** analysis of 4-bromo-2,5-beta-trimethoxyphenethyl-amine (BOB), 4-methyl-2,5-beta-trimethoxyphenethylamine (BOD), 3,4-methylenedioxy-beta-methoxyphenethylamine (BOH), and 4-methyl-2,5-dimethoxy-betahydroxyphenethylamine (BOHD), by LC-MS/MS (toxicological focus) (544); differentiation of stimulant amphetamines, hallucinogenic amphetamines, and nonamphetamines (none specified in the abstract) by GC/FTIR and cluster analysis (545); determination of ephedrine, methamphetamine, and amphetamine by SERS (546); analysis of amphetamine and methamphetamine by GC-MS after propylchloroformate derivatization (547); determination of diethylpropion, fenproporex, and sibutramine in counterfeit tablets, by FTIR/ATR (548); determination of amphetamines and precursors by a portable instrument combining miniaturized GC and IR Absorption Spectroscopy (549); determination of (unspecified) amphetamines by GC/FTIR (550); synthesis and characterization of 2-, 3-, and 4-methylamphetamine by GC/MS, HR-ESI-MS, NMR, and IR (551); a chemometric system for the automated detection of 159 ATSs, using GC/FTIR (552); a review of the 2C series of PEAs (553); analysis of methamphetamine, MDMA, and other ATSs by GC/MS after derivatization with iso-Bu chloroformate and SPME (toxicological focus) (554); detection of volatile compounds that could indicate an ATS by SPME-GC/MS (P2P was detected in every stimulant sample, and 1-phenyl-1,2-propanedione was detected in some stimulant

samples) (555); determination of (unspecified) amphetamines by GC/FTIR (556); a review of impurity profiling and syntheses of methamphetamine, MDMA, amphetamine, DMA, and PMA (557); identification of phenethylamine, ephedrine, and MDMA by Raman, SERS, and DFT (558); analysis of six (unspecified) isomers of mono-methoxyethylamphetamines and mono-methoxydimethylamphetamines (MeO-DMAs) by GC-EI-MS/MS (559); **2014** detection of amphetamines by cluster analysis (560); determination of N-ethyl-α-ethyl-phenethylamine (ETH), N,N-diethylphenethylamine, and phenethylamine in dietary supplements by LC-MS/MS (561); synthesis and SARs of N-benzyl phenethylamines as 5-HT2A/2C agonists (562); potential interferences in the GC/MS analyses of methiopropamine, 4-fluoroamphetamine, 4-fluoromethamphetamine, and 4-methylamphetamine (563); synthesis of [13C6]-labeled amphetamine, methamphetamine, MDA, MDMA, MDEA, PMA, PMMA, 3,5-dimethoxy-phenethylamine, 4-bromo-2,5-dimethoxyphenethylamine, and 2,5-dimethoxy-4-iodophenethyl-amine (564); enantioselective hydrogenation of α,β-disubstituted nitroalkenes to synthesize chiral amphetamines (565); synthesis of phenethylamine via anti-Markovnikov hydroamination of alkenes catalyzed by a two-component organic photoredox system (566); simultaneous enantiomeric separation of methamphetamine, ephedrine, pseudoephedrine, and the chloro-intermediates formed during the Emde method, after derivatization with trifluoroacetic anhydride (567); detection of amine-based stimulants by a novel fluorescent sensor (568); chiral separation of cathinone and amphetamine derivatives by HPLC/UV using sulfated β-cyclodextrin as a chiral mobile phase additive (569); **2015** comparisons of chiral analyses of 10 cathinone and amphetamine-derivatives by CEC, SFC, and 3 different LC methods (570); simultaneous voltammetric detection of MDMA and PMA (571); analysis of ATSs by DSC (572); enantioselective synthesis of ephedrine, amphetamine, and their analogues via two stereocentered Co(III)-catalyzed hydrolytic kinetic resolution of racemic syn-benzyloxy epoxide (573); analysis of amphetamine, methamphetamine, norephedrine, norpseudoephedrine, ephedrine, pseudo-ephedrine, dimethylamphetamine, and methylephedrine by chiral CE/MS (574); determination of MDMA, methamphetamine, MDA, and MDEA by by portable CE with contactless conductivity detection (575); fast separation of 11 cathinones and 4 phenylethylamines by SFC-positive-ESI-triple-quad-MS (576); "novel" sympathomimetics in supplements actually recapitulate the work of synthetic chemists at pharmaceutical firms during the 1930s and 1940s (577); characterization of N-(ortho-methoxybenzyl)-3,4-dimethoxyamphetamine, N-(ortho-methoxybenzyl)-4-ethyl-amphetamine, N-(ortho-methoxybenzyl)-4-methylmeth-amphetamine, and N-(ortho-methoxy-benzyl)-5-(2-aminopropyl)benzofuran by MS, IR, and NMR (578); **2016** electrochemilumines-cent detection of methamphetamine and amphetamine (579);

<u>Barbiturates</u>: 2013 analysis of barbital, phenobarbital, pentobarbital, amobarbital, secobarbital, butalbital, pentothal, and butabarbital by IR and and Raman (580); **2014** by colorimetric sensing (581); computing the acidities of barbituric and thiobarbituric acid (582); a theoretical study on the isomerization and tautomerism of 16 isomers of barbituric acid, using MP2 and B3LYP

(583); **2016** an overview of the polymorphism and tautomerism of barbituric acid (584); a review of the chem. of barbituric acids employed in the design and synthesis of different types of compds (585);

Benzodiazepines: 2013 cross reactivity of 3-hydroxyflunitrazepam, 7-aminonitrazepam, brotizolam, delorazepam, pinazepam, and α-hydroxy-midazolam with a commercial immuno-assay test (includes LC-MS/MS analyses) (586); analysis of 11 different benzodiazepines and metabolites by SERS (benzodiazepines not identified in the abstract) (587); an FTIR/ATR spectral library of benzodiazepines (588); analysis of nitrazepam, clonazepam, lorazepam, chlordiazepoxide, alprazolam, clozapine, and diazepam by HPTLC with densitometric measurement and UV scanning (toxicological focus) (589); **2014** quantum chemical study of some benzodiazepines by density functional theory (590); determination of clonazepam and its related substances in pharmaceutical formulations by HPLC (591); determination of bromazepam, clonazepam, and diazepam in the Guanda River, Brazil (analytical methodology not identified in the abstract) (592); detection of diazepam, flunitrazepam, and temazepam in spiked drinks by GC/MS (593); a review of the analysis of benzodiazepines by LC with electro-chem. detn. (since 2006, with earlier reports given in summary) (594); analysis of diazepam, alprazolam, clorazepate, temazepam, and bromazepam by confocal Raman microscopy (595); differentiation of benzodiazepines by Raman (596); low temperature separation of the inter-converting enantiomers of diazepam, flunitrazepam, prazepam, and tetrazepam by dynamic HPLC on chiral stationary phases (597); detection of benzodiazepines in drinks by electro-phoretic fingerprinting (598); **2015** use of supported liquid extraction for the analysis of benzodiazepines by SERS (599); characterization of clonazolam, deschloroetizolam, flubromazolam, and meclonazepam by NMR, GC-EI-MS, LC-MS/MS, LC-QTOF-MS, and IR (600); determination of diazepam, clonazepam, and alprazolam in dietary supplements by UHPLC-HR-Quad-MS (601); predictive modelling of the toxicity of benzodiazepines using descriptor-based QSTR, group-based QSTR, and 3D-toxicophore mapping (602); a study of the mechanism of mass spectral fragmentation of benzodiazepines (603); analysis of chlordiaz-epoxide, midazolam, nitrazepam, estazolam, oxazepam, lorazepam and alprazolam by HPLC with UV or DAD detection (604); **2016** analysis of benzodiazepines by chip-based electro-chromatography coupled to ESI-MS detection (605); determination of chlordiazepoxide; lorazepam; diazepam; oxazepam; medazepam in an alc. "grappa" drink by packed sorbent (MEPS)-UHPLC-UV (606);

Benzofurans: 2015 pharmacological profile of 5-APB, 5-APDB, 6-APB, 6-APDB, 4-APB, 7-APB, 5-EAPB, 5-MAPDB, and the benzodifuran 2C-B-FLY (607);

Bromo-, Chloro-, and Fluoro- Amphetamines and Methamphetamines: 2013 analysis of 2-, 3-, and 4-chloro- and 2-, 3-, and 4-fluoro- amphetamines by CE-LIF, following derivatization

with fluorescein isothiocyanate (includes comparisons against CZE-UV, sweeping-MEKC-UV, and LC-Q-TOF-MS) (608); synthesis and characterization of fluoroamphetamines and fluoro-methamphetamines by GC/MS and LC-MS/MS, before and after derivatization with various reagents (compounds not specified in the abstract) (609); **2015** discrimination of 2-, 3-, and 4-fluoroamphetamine by Raman (610); differentiation of ring-substituted bromoamphetamine analogs by GC/MS (611); identification of the regioisomers of the chloroamphetamines and chloromethamphetamines by GC-MS/MS (612);

Cathinones: 2012 mass spectral fragmentation of 25 cathinones (not identified in the abstract) by GC-HR-TOF-MS using a soft ionization source (613); analysis of 4-MMC, 4-, 3-, or 2-fluoromethcathinone, 4-methoxymethcathinone, N-ethylcathinone, and N,N-dimethylcathinone by GC/MS (includes a stability study) (614); **2013** characterization of 31 synthetic cathinones (not identified in the abstract) by GC/MS, IR, and NMR (615); analysis of mephedrone, methylone, and MDPV by ambient ionization MS using arrays of low-temperature plasma probes, and also following injection of trifluoroacetic anhydride directly into the plasma stream for online derivatization (616); analysis of BMDP, butylone, MDPBP, MDPV, methylone, and pentylone by HPLC-HR-QTOF-MS (617); analysis of 38 cathinones (not specified in the abstract) by hybrid Q-TOF-MS and LC/MS/MS (618); an overview and review (619); analysis of (unspecified) "bath salt" cathinones by DART-MS (620); an overview and review of synthetic cathinones (621); analysis of 16 cathinones using "presumptive testing" (not specified in the abstract), TLC, and GC/MS (622); an overview of "bath salts" (including mephedrone, MDPV, and possibly others) (623); characterization of metaphedrone and pentedrone by single-crystal X-ray diffraction (624); analysis of 4-methylmethcathinone, three positional isomers of fluoromethcathinones, 4-methoxymethcathinone, N-ethylcathinone, N,N-dimethylcathinone, buphedrone, and pentedrone by GC/MS (625); a review of mephedrone, MDPV (and possibly others) (626); **2014** enantiomeric analysis of 10 new cathinones by CEC on a chiral stationary phase (627); identification of trace levels of synthetic cathinones using Raman (cathinones not identified in the abstract) (628); analysis of 13 synthetic cathinones and associated psychoactive substances by ESI-high performance-IMS (629); identification of MDPV, 3,4-methylenedioxy-α-pyrrolidinobutiophenone (MDPBP), 4-fluoromethcathinone (4-FMC), butylone, mephedrone, naphyrone, 4-methylethcathinone (4-MEC), ethcathinone, α-pyrrolidinopentiophenone (α-PVP), and 3-methyl-α-pyrrolidinopropiophenone (3-MPPP) by GC/FID and GC/MS (630); screening and comparative analysis of synthetic cathinones by portable microchip electrophoresis (631); chiral separation of 12 cathinones by cyclodextrin-assisted CE with UV and MS detection (632); use of DART-MS in-source collision induced dissociation and high mass accuracy for determination of new psychoactive cathinones (633); screening for 16 cathinones by "presumptive testing", TLC, and GC/MS (634); electrochemical detection of (±)-methcathinone, (±)-mephedrone, and (±)-4'-methyl-N-ethylcathinone (635); electroanalytical sensing of mephedrone and methylethcathinone (636); synthesis and characterization of 9 new derivs. of

cathinone (obtained by modifying the carbonyl group to create cyclic ketals and thioketals, oximes, and hydrazones of cathinone and of cathinone phthalimide; analytical methodologies not identified in the abstract) (637); QSAR modelling of 4-methylbuphedrone and 4-methoxy-N,N-dimethylcathinone, with comparison to methylone (638); characterization of 4-fluoromethcathinone, ethcathinone, buphedrone, methedrone, pentedrone, 3,4-dimethylmethcathinone, 4-methylethcathinone, and others by FTIR, GC/MS, 1HNMR, and wavelength dispersive XRF (639); **2015** analytical and synthetic studies on substituted cathinones (no details provided in the abstract) (640); analysis of methcathinone, 3,4-methylenedioxymethcathinone, 3,4-methylenedioxypyrovalerone, and 4'-methyl-α-pyrrolidinopropiophenone by LC/MS (641); isotopic profiling of cathinones for comparative analyses (642); identification and characterization of α-PVT, α-PBT, and their bromothienyl analogs (643); a review of the R- and S- isomers of cathinones, focusing on MDPV (644); an overview and review of the neurotoxicity of the cathinones (645); identification and characterization of 4-fluoro-PV9 and α-PHP by HPLC, HPLC/DAD, ESI-Ion-Trap-MS in MS2 and MS3 modes, GC/MS, thermogravimetric anal., DSC, FTIR, UV/Vis, and NMR (646); compatibility of highly sulfated cyclodextrin with ESI at low nanoliter/minute flow rates and its application to CE-ESI/MS analysis of cathinone derivatives (647); the electrochemical detection of mephedrone (4-MMC) and 4'-methyl-N-ethylcathinone (4-MEC) (648); a study of the decomposition of the HCl salts of 8 cathinone derivatives in air (649); crystal structures of two forms of MDPV HCl and one form of ethylone HCl (650); preparation and characterization of the tertiary cathinones N,N-dimethylcathinone, N,N-diethylcathinone, and 2-(1-pyrrolidinyl)-propiophenone by NMR and MS (the enantiomers were also prepared and identified by HPLC and CD) (651); analysis of (±)-4'-methylmethcathinone and (±)-4'-methyl-N-ethylmethcathinone by HPLC/UV and amperometric detection ("NRG-2" is a focus) (652); **2016** differentiation of cyclic tertiary amine cathinone derivatives (the cyclic amines azetidine, pyrrolidine, piperidine, and azepane were incorporated into a series of cathinones related to MDPV) by product ion-EI-MS and MS/MS (653); thermal degradation of 4-ethylmethcathinone, 4-methylethcathinone, buphedrone, butylone, ethcathinone, ethylone, flephedrone, 3,4-methylenedioxy-α-pyrrolidinobutiophenone, 3,4-methylenedioxypyrovalerone, mephedrone, methcathinone, methedrone, methylone, 4-methyl-α-pyrrolidinobutiophenone, naphyrone, pentedrone, pentylone and pyrovalerone under GC/MS conditions (654); identification of methylone and pentedrone by NMR, IR, UV/Vis, MS/MS, and HR-TOF-MS (655); identification and characterization of iso-4-BMC, β-TH-naphyrone, mexedrone, and 4-MDMC by LCQTOF-MS, GC/MS, and NMR (656); chiral separation of new cathinones on chiral ion-exchange type stationary phases (657);

"Ecstasy Tablets" (that is, Tablets or Powders specified in their Titles or Abstracts as Ecstasy - these may in fact contain MDMA, a mixture of MDMA with one or more other Drugs, or only one or more non-MDMA drugs): 2013 elemental analysis of Ecstasy tablets by graphite furnace atomic absorption, for comparative analysis (abstract indicates Cu, Mg, Ba, Ni,

Cr, and Pb) (658); **2014** determination of metals (Zn, Al, Ca, Mg, K, Na, Ba, Fe, B, Cu, and Pt) in Ecstasy tablets using ICP-OES and XRF (659); **2015** a discussion of "luminescent" Ecstasy tablets (a marketing ploy) (660); detection of MDMA, methamphetamine, and 20 other substances in Ecstasy tablets, including caffeine, 2C-B, piperazines, amphetamines, and phencyclidine, by GC/MS (661); **2016** comparison of the purity and adulteration of the crystalline (powder) samples versus tablets in the Spanish Ecstasy market 2000-2014, by TLC, GC/MS, and UV (662);

Ephedrines: 2012 interconversion of ephedrine and pseudoephedrine during heptafluorobutyric anhydride derivatization (663); **2013** comparison of RP-UHPLC and HILIC for quantitation, with medium-resolution accurate MS (664); **2014** identification of ephedrine by use of charge-transfer complexes (with analysis of the complexes by elemental anal., IR, Raman, 1H NMR, and UV-Vis (665);

Ergot Alkaloids: 2014 a review of the biosynthetic pathways of ergot alkaloids (666); detection of ergometrine, ergosine, ergotamine, ergocornine, ergocryptine, ergocristine) in rye and triticale grains (analytical methodologies not identified in the abstract) (667); determination of ergot-amine tartrate in tablets using LC with fluorimetric and UV detection (668); an overview of the biosynthesis of the ergot alkaloids (669); identification of ergot alkaloid in two Argyreia nervosa "legal high" products by HPLC-HRMS/MS (670); a review of the detection of ergot alkaloid derivatives by TLC (671); aptamer-based extraction of ergot alkaloids from ergot contaminated rye feed (672); **2015** determination of ergot alkaloids in grain products by LC-ion trap-MS (673); an evaluation of fast dissolving tablets of ergotamine tartrate (674); determination of ergovaline in tall fescue seed and straw using a QuEChERS extraction method by HPLC with fluorescence detection (675); **2016** an overview and review (676); quantitative and qualitative transcriptome analysis of four industrial strains of Claviceps purpurea with respect to ergot alkaloid production (677); determination of ergot alkaloids in Morning Glory cultivars by LC-Q-TOF-MS (678); screening for total ergot alkaloids in rye flour by planar SPE-fluorescence detection and MS (679);

Fentanyl Derivatives: 2014 analysis of the inclusion complexes between cyclodextrins and fentanyls by NMR and computational studies (680); an efficient, optimized synthesis of fentanyl and related analogs (681); **2015** improved and optimized syntheses of fentanyl and related analogs (682);

2-, 3-, and 4-Fluorophenmetrazines: 2016 synthesis, characterization, and differentiation of the fluorophenmetrazine isomers (683);

"FLY" Compounds: 2014 synthesis of labeled 2C-B-FLY and Bromo-DragonFLY for use as

internal standards (684);

Methiopropamine (and its 3-thienyl isomer): 2013 synthesis and analysis/differentiation by GC (685);

NBOMe Compounds: 2013 characterization of 25D-NBOMe [2-(2,5-dimethoxy-4-methyl-phenyl)-N-(2-methoxybenzyl)ethanamine], 25E-NBOMe [2-(4-ethyl-2,5-dimethoxyphenyl)-N-(2-methoxybenzyl)ethanamine], and 25G-NBOMe [2-(2,5-dimethoxy-3,4-dimethylphenyl)-N-(2-methoxybenzyl)ethanamine (686); **2014** an overview and review (687); **2015** a review (688); detection of NBOMEs (and other NPSs) on blotter papers by direct ATR-FTIR (689); analysis of 25I-NBOMe, 25BNBOMe, 25C-NBOMe and other dimethoxyphenyl-N-[(2-methoxy-phenyl)methyl]ethanamine derivatives on blotter paper by DART-Accu-TOF-MS and HPLC-triple quadrapole-MS (690); an overview (691);

Opiates: 2012 determination of morphine and codeine by HPLC-quadrupole mass selective detection (may be a toxicological study) (692); **2013** analysis of morphine and codeine by TLC and densitometry (693); **2014** some insights into hydrate formation and stability of morphinanes by powder X-ray diffraction, IR, DSC, and isothermal calorimetry (694); isomerization of codeine and morphine into hydrocodone and hydromorphone using a water-sol. rhodium complex formed from com. available [Rh(COD)(CH3CN)2]BF4 and 1,3,5-triaza-7-phospha-adamantane (695); a review of the TLC of morphine analogs (compounds not identified in the abstract) (696); **2015** potential use of oriental poppy hairy roots for producing thebaine, morphine, and codeine (697); a review covering the synthesis of buprenorphine, naltrexone, naloxone, and nalbuphine from naturally occurring opiates such as thebaine and oripavine (698); the stereochemistry and spectral assignment of thebaine derivatives based on a 1D NOESY NMR study (699); degradation of morphine and codeine by gamma radiation in methanol (700); radiation induced destruction of thebaine, papaverine, and noscapine in methanol (701); a review of AH-7921 (702); separation of morphine, hydromorphone, and norcodeine using ESI and paper spray coupled to high-field asymmetric waveform IMS (703);

Opiates (Bio-Engineered): 2014 use of a microbial biomanufacturing platform for natural and semisynthetic opioids, using Saccharomyces cerevisiae (704); **2015** heroin from bio-engineered yeast (705); heroin from bio-engineered yeast (706); failure of an attempted large-scale effort to produce thebaine using home-brew type conditions (707); synthesis of morphinan alkaloids from norlaudanosoline using Saccharomyces cerevisiae (708); a feasibility study for production of thebaine and hydrocodone from sugar by bio-engineered yeast (709); a review, detailing the current status of microbial benzylisoquinoline alkaloid synthesis and derivatization (710); a call to regulate the synthesis of morphine by bio-engineered yeasts (711); **2016** metabolic engineering for the production of plant isoquinoline alkaloids (712); complete biosynthesis of opioids

(thebaine) by yeast (713); a review of the production of thebaine and hydrocodone from D-glucose by fermentation (714); total biosynthesis of opiates (thebaine) by stepwise fermentation using engineered E. coli (715);

1-(1-Phenylcyclohexyl)piperidine (PCP) and 1-(1-phenylcyclohexyl)pyrrolidine (PCPy) analogues: 2014 characterization by GC-ion trap-EI-, CI-, and HR-MS, LC-ESI-triple-quadrupole linear ion trap-MS/MS, IR, DAD, and 1H and 13C NMR (716);

Phenothiazines: 2013 separation and identification of prochlorperazine, promethazine, chlorpromazine, and trifluoroperazine (717);

Phosphodiestrase-5 Inhibitors - Cialis (tadalafil), Levitra (vardenafil), Viagra (sildenafil), and similar drugs: 2013 a multivariate-based wavenumber selection method for classifying Cialis and Viagra into authentic or counterfeit classes by ATR/FTIR (718); analysis for residual solvents in counterfeit tablets and capsules of Cialis and Viagra (analytical method not indicated in the abstract) (719); simultaneous qualitative and quantitative analysis of counterfeit Cialis by Raman (720); analysis of 38 compounds (sildenafil, tadalafil, vardenafil and their analogs) in illicit erectile dysfunction products by LC-ESI-MS/MS (721); differentiation between counterfeit and authentic Cialis and Viagra by ATR/FTIR with PCA (722); analysis and profiling by UPLC/MS (723); characterization of sildenafil citrate tablets from different sources by NIR chemical imaging and chemometric tools (724); **2014** profiling authentic and counterfeit Viagra and Cialis using XRF, direct infusion ESIMS, UPLC-MS, and ATR-FTIR (725); simultaneous determination of of sildenafil, tadalafil, vardenafil and acetildenafil in health-care foodstuffs by UHPLC/MS (726); qualitative and quantitative analysis of sildenafil in traditional medicines and dietary supplements by HPLC/UV and IR (727); **2015** isolation and structural characterization of chloropropanoylpretadalafil in a dietary supplement by HPLC-UV, GC/FT-IR/MS, and HRMS (728); detection of sildenafil citrate in herbal formulations by UV/Vis (729); differentiating genuine and counterfeit Viagra tablets by dynamic thermal analysis (730); **2016** use of transmis-sion-mode desorption electrospray MSMS to screen for synthetic phosphodiesterase-5 inhibitors in samples of adulterated herbal dietary supplements (731); analysis of dietary supplements containing phosphodiesterase type-5 (PDE-5) inhibitors by LC/MS and HPLC/UV (732);

Piperazines: 2012 differentiation of methylenedioxybenzylpiperazines and ethoxybenzyl-piperazines by GC/IRD and GC/MS (733); **2013** characterization of six ring regioisomeric dimethoxybenzoylpiperazines (DMBzPs) by GC/MS and GC/IRD (734); analysis of the six-ring regioisomeric dimethoxybenzyl-N-methylpiperazines (DMBMPs) by GC/MS (735); a presumptive color spot test method for the detection of benzylpiperazine and piperazine analogues (736); determination of chlorophenylpiperazine isomers by CE (737); analysis of phenyl and benzyl piperazines by HPLC with chemiluminescence detection (738); **2014** six ring

regionisomeric dimethoxybenzoyl-N-methylpiperazines (DMBzMPs) by GC/MS and IR (739); analysis of regioisomeric bromodimethoxy benzyl piperazines related to 4-bromo-2,5-dimethoxy-benzylpiperazine by GC/MS and FTIR (740); differentiation of the 1-(methylenedioxyphenyl)-2-piperazinopropanes and 1-(methoxyphenyl)-2-piperazinopropanones by GC/IRD and GC/MS (741); **2015** analysis of six ring regioisomeric dimethoxyphenylpiperazines (DOMePPs) by GC/MS and IR (742); analysis of 23 benzylpiperazine (BZP) and trifluoromethylphenyl-piperazine (TFMPP) containing tablets by HPLC and IRMS (743); an overview of 1-cyclohexyl-4-(1,2-diphenylethyl)piperazine (MT-45) (744);

Steroids: 2013 determination of tetrahydrogestrinone and related anabolic androgenic steroids by MEKC (745); a study of authentic and counterfeit products (primarily stanozolol, testosterone, and nandrolone) seized in Brazil from 2006 to 2011 (746); analysis of methandienone and methyltestosterone in tablets by color testing and GC/MS (747); a review of the bioanalytical challenges in detecting unknown anabolic androgenic steroids (in doping control analysis) (748); screening for steroids in traditional medicine and nutraceutical products using electrospun cellulose acetate nanofibers as thin layer chromatographic media (749); **2015** analysis of anabolic steroids by GC-EI/MS, GC-EI/MS/MS, LC-ESI/MS/MS, LCAg+CIS/MS/MS, and GC-ESI/MS/MS (for doping control) (750); determination of anabolic-androgenic steroid adulterants in counterfeit drugs by UHPLC-MS/MS (751); identification and quantification of anabolic steroid esters by DART-HRMS (752); an overview and review of the anabolic androgenic steroids in supplements (753); determination of anabolic agents in dietary supplements by LC-HRMS (754); a summary of the designer steroids that are most commonly sold in dietary supplements (as of April 2014) (755); **2016** improved detection of steroids and evidence for their regiospecific decompositions using anion attachment MS (756); analysis of steroids in dietary supplements by non-targeted mass spectrometry (757); analysis of anabolic steroids by GC-CI-TQuad-MS (758);

Tryptamines (see also Mushrooms): 2013 characterization of AMT (3-(2-aminopropyl)indole) and 5-IT (5-(2-aminopropyl)indole) by 1H- and 13C-NMR, GCEI/CI-ion trap-MS, U/HPLC-DAD, and HPLC/MS (759); simultaneous determination of tryptamine analogues in designer drugs using GC/MS and LC-MS/MS (only 5-methoxy-N,N-diethyltryptamine and 5-methoxy-N-methyl-N-isopropyltryptamine were identified in the abstract, among many more) (760); **2015** a review of the use, analysis, and toxicity of tryptamines (only DMT is specifically noted in the abstract) (761); **2016** synthesis of psilocin, bufotenin, serotonin, and various homologues and branched tryptamine derivatives (762); characterization of N,N-diallyltryptamine (DALT), and 2-phenyl-, 4-acetoxy-, 4-hydroxy-, 4,5-ethylenedioxy-, 5-methyl-, 5-methoxy-, 5-methoxy-2-methyl-, 5-ethoxy-, 5-fluoro-, 5-fluoro-2-methyl-, 5-chloro-, 5-bromo-, 5,6-methylenedioxy-, 6-fluoro-, 7-Me, and 7-ethyl DALTs, by NMR, GC/MS, EI/MS, low and high mass accuracy MS/MS, PDA, and GC solid-state IR (763).

1.D - Synthetic Cannabinoids and Cannabimimetics [Notes: Compounds are listed either by their acronym or full name as was specified in their respective abstract - no effort was made to transcribe acronyms to full chemical names or vice versa. Articles that include both synthetic cannabinoids and/or cannabimimetics with other drugs are detailed separately.]

Individual Synthetic Cannabinoids and Cannabimimetics: 2013 identification of (1-(cyclohexylmethyl)-1H-indol-3-yl)(4-methoxynaphthalen-1-yl)methanone by LC/MS and NMR (764); purification and characterization of 3-methyl-6-[3-(trifluoromethyl)-phenyl]-1,2,4-triazolo[4,3-b]pyridazine (CL 218872) by MS, IR, and NMR (765); characterization of JWH-213 by LC-PDA-MS, GC/MS, high-res MS, and NMR (766); analysis of N-[3-(2-methoxyethyl)-4,5-dimethyl-2(3H)-thiazolylidene]-2,2,3,3-tetramethylcyclopropanecarboxamide (A-836339) by LC/MS, GC/MS, highres MS, NMR, and X-ray crystallography (767); identification of [1-(tetrahydropyran-4-ylmethyl)-1H-indol-3-yl](2,2,3,3-tetramethylcyclopropyl)-methanone (A-834,735) by LC-ESI-QTOFMS, GC/MS, 1D- and 2D-NMR, and FTIR (768); **2014** an outbreak of exposure to a novel synthetic cannabinoid (abstract not available) (769); analysis of methyl 2-{[1-(5-fluoropentyl)-3-methyl-1h-indol-3-ylcarbonyl]amino}butyrate (770); structural elucidation of a new open chain isomer of the cannabimimetic cyclopropoylindole A-796,260 by NMR and MS (771); determination of HU-210 by HPLC (772); identification of JWH-018 by LC-MS/MS (773); **2015** isolation and identification of AB-FUBINACA (774); structural elucidation of N-(1-amino-3,3-dimethyl-1-oxobutan-2-yl)-1-(5-fluoropentyl)-3-(4-fluorophenyl)-pyrazole-5-carboxamide (a homolog of AZ-037) by NMR and MS (775); characterization of naphth-1-yl 1-(5-fluoropentyl)-1H-indole-3-carboxylate (CBL-2201) by 1H, 13C, and 15N NMR, FTIR, and GC/MS (776); new monoclonal antibodies specific for 1-(5-fluoropentyl)-3-(2-iodo-benzoyl)indole (AM694) (777); identification of N,N-bis(1-pentyl-indol-3-yl-carboxy)naphthyl-amine (BiPICANA) by LC/MS, HRMS, NMR, and X-ray crystallography (778); analysis of AB-CHFUPYCA [N-(1-amino-3-methyl-1-oxobutan-2-yl)-1-(cyclohexylmethyl)-3-(4-fluoro-phenyl)-1H-pyrazole-5-carboxamide] by GC/MS, LC/MS, LC/HRMS, and NMR (779); **2016** determination of the absolute configuration of MDMB-CHMICA by vibrational and electronic CD spectroscopy, Xray crystallog., and HPLC (780); separation and structural characterization of JWH-018-cyclohexyl methyl derivative (NE-CHMIMO) by flash chromatography, GC/MS, IR, and NMR (781); analysis of 3-benzyl-5-[1-(2-pyrrolidin-1-ylethyl)-1H-indol-3-yl]-1,2,4-oxa-diazole by GC/MS, GC/HRMS, UHPLC/HRMS2, FTIR, and 1H and 13C NMR (782);

Multiple Synthetic Cannabinoids and Cannabimimetics:

[Note: Each year in this subsection is separated by a line space.]

2012 separation and structural characterization of JWH-412 and 1-[(5-fluoropentyl)-1H-indol-3-yl]-(4-methylnaphthalen-1-yl)methanone using GC/MS, NMR, and flash chromatography (783); analysis of cannabinoids by IR, GC/MS, LC/MS, and 1H NMR (784); analysis of CP-47,497-C8 JWH-250, and RCS-4 by TLC, GC/MS, light optical microscopy, and "phytochemical reactions" (785);

2013 analysis of JWH-018, JWH-019, JWH-073, and JWH-250 by GC/MS (786); analysis of 5F-UR-144 and UR-144 by GC/MS, LC-TOF-MS, and 1D-and 2D-NMR (787); an overview of synthetic cannabinoids in South Korea from 2009 to June 2013 (788); analysis of AM-2201, JWH-203, JWH-210 and RCS-4 by LC, high-res MS, LCQTOF-MS, and NMR (789); correlated results from the analyses of synthetic cannabinoids in Turkey from 2010 to 2012 (790); analysis of JWH-019, JWH-081, JWH-203, and JWH-250 by UHPLC-QTOF-MS (791); analysis of 28 (unspecified) "synthetic cannabinoids" by LC/ESI-MS/MS (toxicological focus) (792); isolation of cis- and trans- CP-47,497-C8 (and others not specified in the abstract) - extraction from plant materials by flash chromatography (793); analysis of azepane isomers of AM-1220 and AM-2233, AM-2233, and URB-597 by LC/MS, GC/MS, "accurate MS," and NMR (794); isolation and analysis of 1-butyl-3-(2-methoxybenzoyl)indole and the 2-methoxy isomer of RCS-4 by column chromatography and prep-HPLC, followed by GC/MS, ESI-TOFMS, and 1D- and 2D-NMR (795); a review of the analysis of synthetic cannabinoids on botanical materials (796); analysis of (unspecified) "cannabimimetics" bearing 2,2,3,3-tetramethylcyclopropane-carbonyl moieties by GC/MS, LC/MS, and NMR (797); characterization of some synthetic cannabinoids, derivatives of indole-3-carboxylic acid, by GC-HRMS, UHPLC-HRMS, NMR, and FTIR (798); detection of AB-001, AM-2232, APINACA, N,5-dimethyl-N-(1-oxo-1-(ptolyl) butan-2-yl)-2-(N'-(p-tolyl)ureido)benzamide, (4-ethylnaphthyl)-AM-2201 (EAM-2201), 5-fluoropentyl-3-pyridinoylindole, 5FUR-144 (synonym: XLR11), 4-hydroxydiethyltryptamine (4-OH-DET), JWH-213, JWH-307, JWH-030, 4-methylbuphedrone, (4-methylnaphthyl)-AM-2201 (MAM-2201), (4-methylnaphthyl)-JWH-022 [synonym: N-(5-fluoropentyl)-JWH-122], N-(4-pentenyl)-JWH-122, UR-144, and URB-754 on plant materials (methods not specified in the abstract) (799); analysis of N-(1-amino-3-methyl-1-oxobutan-2-yl)-1-pentyl-1H-indazole-3-carboxamide (AB-PINACA) and N-(1-amino-3-methyl-1-oxobutan-2-yl)-1-(4-fluorobenzyl)-1H-indazole-3-carboxamide (AB-FUBINACA) by LC/MS, GC/MS, high-res MS, and NMR (800); a pharmacological study of the structural features of synthetic cannabinoids and their in vivo cannabimimetic activity (801); simultaneous determination of JWH-018 and JWH-073 by UFLC (Ultra-Fast LC) (802); analysis of cannabicyclohexanol, JWH-018, JWH-073, JWH-081, JWH-122, JWH-210, JWH-250, and RCS-4 by GC/MS, LC-QTOF-MS, and HPLC (803);

2014 an overview of the emergence, identification, legislation and metabolic characterization of synthetic cannabinoids in herbal incense products (804); chromatographic and mass spectral studies on 6 1-pentyl-acylindoles (regioisomeric synthetic cannabinoids) (805); analysis and

differentiation of substituted 1-alkyl-3-acylindoles (isomeric synthetic cannabinoids) by GC-MS, IR, and some exact mass GC-TOF-MS (806); differentiation of 1-alkyl-3-acylindoles and 1-acyl-3-alkylindoles (isomeric synthetic cannabinoids) by GC MS, and IR (807); a review (808); differences in the GC-EI-MS spectra of JWH-250, JWH-302, and JWH-201 (809); presumptive color-testing of synthetic cannabimimetics by Duquenois-Levine, van Urk, and 2,4-DNPH (810); analysis of AM-2201, JWH-122, JWH-203, JWH-210, and RCS-4 by DART-MS (811); identification and quantification of synthetic cannabinoids by GC/MS and GC/ECD (812); synthesis and biological activities of synthetic cannabinoids (813); structural elucidation, analytical characterization, and identification of [1-(5-fluoropentyl)-1H-indazol-3-yl-(naphthalen-1-yl)methanone, naphthalen-1-yl(1-pentyl-1H-benzo[d]imidazol-2-yl)methanone, and 1-(5-fluoropentyl)-1H-benzo[d]imidazol-2-yl(naphthalen-1-yl)methanone by GC/MS, GC/HR-MS, UHPLC-HR-MS, NMR, and FT-IR (814); identification and analysis of indol-3-carboxylates series and indazole-3-carboxylates (novel cannabinoids) by GC/MS, GC-HRMS, UHPLC-HRMS, NMR, and FTIR (815); analysis of the 6 benzoyl-substituted 1-pentylindoles (isomeric synthetic cannabinoids) by GC/MS and FTIR (816); simultaneous determination of 10 synthetic cannabinoids by HPLC (817);

2015 a retrospective survey of synthetic cannabimimetics in Bulgaria 2010-2013 (818); synthesis and SARs of RCS-4 and its regioisomers and C4 homologue (819); identification of 8-quinolinyl 4-methyl-3-(1-piperidinylsulfonyl)benzoate (QMPSB), MAM-1220, and CHM-081 by GC/MS, LC/MS, and NMR (820); synthesis and spectroscopic analysis of analogues of 1H-indol-3-yl-(2,2,3,3-tetramethylcyclopropyl)methanone and 1H-indol-3-yl(adamantan-1-yl)methanone by NMR, MS, FTIR, and GC-FTIR (821); quantitation of 32 synthetic cannabinoids (dibenzopyrans, cyclohexylphenols, naphthoylindoles, benzoylindoles, phenylacetylindoles, tetramethylcyclo-propylindoles) on plant materials by a validated HPLC/UV method (822); QSARs of 43 cannabimimetic aminoalkilindole derivatives and their metabolites (823); qualitative and quantitative analysis of 2 fluorine containing cannabinoids (XLR-11 and AM-2201) by 19F-NMR, with comparison against GC/MS (824); the variability of active ingredients in Spice within Alaska as an indicator mechanism for manufacture and distribution (825); rapid screening and quantification of synthetic cannabinoids in herbal products with COSY and TOCSY NMR (826); separation of cannabinoids on 3 different mixed-mode columns (827); an overview and review of synthetic cannabinoids (828); differentiation of the positional isomers of JWH-081 by GC-EI-MS and GC-MS/MS (829); identification and quantification of 5-fluoro-AB-PINACA, AB-CHMINACA, AB-FUBINACA, 5-fluoro-PB-22, 5-fluoro-AMB, MDMB-CHMICA, EAM-2201, and STS-135 by GC/MS (830); identification of synthetic cannabinoids by UHPLC-TOFMS and GC/MS (among 32 solutes, only JWH-018 and CP47,497 are identified in the abstract) (831); synthesis and characterization of N-(1-amino-3-methyl-1-oxobutan-2-yl)-1-(cyclohexylmethyl)-3-(4-fluorophenyl)-1H-pyrazole-5-carboxamide (3,5-AB-CHMFUPPYCA) and differentiation from its 5,3-regioisomer (832); analysis of ADB-BINACA, AB-FUBICA,

ADB-FUBICA, and AB-BICA by LC-HRMS, GC/MS, and NMR (833); identification and analytical characteristics of 5 new synthetic cannabinoids with an indazole-3-carboxamide structure bearing an N-1-methoxycarbonylalkyl group by GC/MS, GC/HRMS, UHPLC-HR-MS/MS, and 1H and 13C NMR (834); a review of synthetic cannabinoids (835); analysis of 1-n-pentyl-3-(1-naphthoyl)indole (JWH-018), three deuterium-labeled analogues, and the inverse isomer 1-naphthoyl-3-n-pentylindole by MS (836); analysis of JWH-018 and its 5 regioisomers by GC/MS (837); separation and detection of cannabicyclohexanol (CCH: cis-isomer), trans-CCH, 5-(1,1-dimethylheptyl)-2-[(1R,3S)-3-hydroxycyclohexyl]-phenol (CP-47497), 5-(1,1-dimethylheptyl)-2-[(1R,2R,5R)-5-hydroxy-2-(3-hydroxypropyl)-cyclohexyl]-phenol (CP-55940), 3-(1,1'-dimethylheptyl)-6aR,7,10,10aR-tetrahydro-1-hydroxy-6,6-dimethyl-6H-dibenzo[b,d]pyran-9-methanol (HU-210), 2-[1R-3-methyl-6R-(1-methylethenyl)-2-cyclohexen-1-yl]-5-pentyl-1,3-benzenediol (CBD), (1-pentyl-1H-indol-3-yl)-1-naphthalenyl-methanone (JWH-018), (1-butyl-1H-indol-3-yl)-1-naphthalenyl-methanone (JWH-073) and 1-(1-pentyl-1H-indol-3-yl)-2-(2-methoxyphenyl)-ethanone (JWH-250) by SFC/MS (838); an overview of illnesses and deaths from abuse of synthetic cannabinoids (839); syntheses and analytical characterizations of 15 N-alkyl-arylcyclohexylamines by GC and HPLC coupled to multiple forms of mass spectrometry, as well as NMR, UV/DAD, and IR (840); characterization of 2 thiazolylindoles and a benzimidazole (potential cannabinoids) by MS, IR, and NMR (841); a review of bioisosteric fluorine in the clandestine design of synthetic cannabinoids (842); identification and quantitation of 5-fluoro-ADBPINACA and MAB-CHMINACA by HRMS, GC/MS, and LC-MS/MS (843); a study on the fragmentation pathways of JWH-018 and JWH-073 (844); determination and identification of synthetic cannabinoids and their metabolites in different matrices by chromatographic, spectroscopic, and spectrometric methods (845);

2016 differentiation of the 6 regioisomeric dimethoxybenzoyl-1-pentylindoles by EIMS and FT-IR (846); a study of the fragmentation of 21 synthetic cannabinoids with an iso-Pr group or a tert-Bu group by EI-Quad-MS and positive ESI-TOF-MS (847); analysis of 22 synthetic cannabinoids, and separately of JWH018 and 9 of its positional isomers, by ultra high performance SFC (848); variation in commercial "smoking mixtures" containing third-generation synthetic cannabinoids (849); identification of 6 synthetic cannabinoids by DART-LTQ ORBITRAP (850); identification of APINACA 2H-indazole analogue, AMPPPCA, and 5F-AMPPPCA by LC-QTOF-MS, GC-TOF-MS, and NMR (851); differentiation of JWH-122 and JWH-210 by GC-EI-MS/MS (852); analysis of 5F-AMB and PX-3 by 1H and 13C NMR, HR-MS/MS, and Raman (853); an overview and review of recent international trends in Spice use (854); analysis of the 2-alkyl-2H-indazole regioisomers of synthetic cannabinoids AB-CHMINACA, AB-FUBINACA, AB-PINACA, and 5F-AB-PINACA (possible manufacturing impurities with cannabimimetic activities) by 1H and 13C NMR, GC/MS, and UV/Vis (855); rapid identification of 10 synthetic cannabinoids by DART-MS and NMR (856); use of a QSAR model to determine the affinity of synthetic cannabinoids to the CB1 receptor

(857); identification and characterization of ADB-BICA, NNL-1, NNL-2, and PPA(N)-2201 by LC-QTOF-MS, GC/MS, FTIR, and NMR (858); determination of 8 synthetic cannabinoids by heat assisted sample introduction and dielectric barrier discharge ionization MS (859);

Synthetic Cannabinoids and Cannabimimetics with Other Drugs (except when a minor part of a larger study): 2012 identification of atropine, scopolamine, lysergamide mitragynine, 4-methoxymethcathinone, 3-fluoromethcathinone, JWH-073, JWH-081, JWH-0250, and JWH-0251 in "herbal products" purchased via the Internet in 2009 and 2010 by LC/PDA/MS and GC/MS (860); analysis of CP-47,497, CP-47,497-C8, JWH-018, JWH-073, JWH-200, MDPV, mephedrone, and methylone by UHPLC/TOFMS (861); **2013** a review, including a comparison of the natural and synthetic cannabinoid materials (862); identification of ADB-FUBINACA, ADBICA, AM-2201 4-methoxynaphthyl analog, APICA N-(5-fluoropentyl) analog, APINACA N-(5-fluoropentyl) analog, JWH-122 N-(5-chloropentyl) analog, QUPIC, QUCHIC, and UR-144; N-(5-chloropentyl) analog (alpha-pyrrolidinovalerothiophenone (alpha-PVT) and 3,4-dichloro-N-([1-(dimethylamino)cyclohexyl]methyl)benzamide (AH-7921) also identified) (863); an overview of Psilocybe mushrooms, 5-MeO-DIPT, tryptamine, MDMA and related compounds, synthetic cannabinoids, and cannabimimetics (864); **2014** analysis of piperazine derivatives (BZP, MPMP, TFMPP), cathinone derivatives (N-ethylcathinone, buthylone, ethylone, methylone, buphedrone, flephedrone), pyrovalerone derivatives (MDPV, naphyrone), and synthetic cannabinoids (AM-694, JWH-019, JWH-073, JWH-081, JWH-122, JWH-200, JWH-250), by GC-EI-MS (865); determination of AM-2201, JWH-018, JWH-022 JWH-073, JWH-122, JWH-203, JWH-210, JWH-250, HU-210, RCS-4, THC, and various metabolites by UHPLCMS/ MS (866); analysis of cocaine, methylone, 4'-methylethcathinone, 3,4-MDPV, JWH-210, JWH-250, and JWH-203 by ion mobility-TOF-MS (867); analysis of a mixture of diphenidine and 5-fluoro-AB-PINACA (868); **2015** an overview of cannabis vs. synthetic cannabinoids (869); an overview of synthetic cathinones and cannabinoids (870); a review of a major researcher's 50 years of research on cannabinoids, with future-looking comments (871); analysis of synthetic cathinones and cannabimimetic agents by MS, LC/MS, LC-MS/MS, NMR, IR, and DART-MS (872).

1.E - Polydrug A: Mixed or Unrelated Individually Named Compounds or Substances

[Note: Each year in this subsection is separated by a line space.]

2012 analysis of cocaine, heroin, and MDMA by spectral fluorescence (873); use of a modified multiwall carbon nanotubes paste electrode for simultaneous voltammetric determination of morphine and diclofenac in biological and pharmaceutical samples (874); an extended overview

and review of "date-rape" drugs (GHB, MDMA, flunitrazepam, and ketamine) (875);

2013 detection of flunitrazepam, ketamine, and MDMA by IMS (toxicological focus) (876); analysis of methoxetamine, 3-methoxyeticyclidine, and 3-methoxyphencyclidine by GC- and CI-MS, NMR, and HPLC-DAD-ESI-MS/MS (toxicological focus) (877); identification of 1,4-benzobenzodiazepines (clonazepam, flurazepam, alprazolam, midazolam, bromazepam, chlordiazepoxide, lorazepam, and diazepam) and antidepressants (bupropion, sertraline, paroxetine, and fluoxetine) as adulterants in phytotherapeutic dieting formulations by voltammetry (878); differentiation of anorexics (amfepramone, fenproporex, sibutramine), benzozodiazepinic anxiolytics (clonazepam, flurazepam, alprazolam, midazolam, medazepam, chlordiazepoxide, diazepam), antidepressants (bupropione, fluoxetine, sertraline, paroxetine), diuretics (hydrochlorothiazide, furosemide, chlortalidone, amiloride, spironolactone), and hypoglycemics (glimepiride, chlorpropamide, glibenclamide) by a solid state electrochemical method (879); analysis of tramadol and morphine by spectrofluorimetry and spectrophotometry (880); determination of morphine, nalbuphine, and "naltrexone drugs" in bulk and pharmaceutical formulations by a kinetic spectrophotometric method (881); determination of tramadol, morphine, nalbuphine and naltrexone analgesic drugs using potassium permanganate and spectrophotometry (882); determination of 13 sedative-hypnotics in health foods (including phenobarbital, estazolam, and diazepam) by HPLC-MS/MS (883); detection of lidocaine, diazepam, and ketamine as adulteration in foodstuffs and beverages by HPLC (884); analysis of methaqualone, saccharin, paracetamol, and phenacetin in illicit drugs by HPLC (885); an overview of the analyses of BZP, mephedrone, JWH-018, TFMPP, sage poet, kratom, fly agaric, kava-kava, and others (886); determination of 4 cathinones (mephedrone, butylone, 4-Me-PPP, and 4-MEC) and 5 tryptamines (5-EtO-DPT, 5-EtO-DALT, 5-EtO-MIPT, 5-EtO-ALCHT, and 5-EtO-2-MALET by ESI-AP-Ion Mobility-TOF-MS (887); identification of kratom, 2C-C-NBOMe, 25I-NBOMe, RH-34 and UR-144, 2-(2,3-dimethoxyphenyl)-N-(3,4,5-trimethoxybenzyl)ethanamine (DMA-NBTOMe), acetylated 25I-NBOMe, acetylated DMA-NBTOMe by GC/MS and NMR (888); analysis of barbital, clozapine, chlordiazepoxide, midazolam maleate, phenobarbital, perphenazine, promethazine HCl, chlormezanone, nitrazepam, amobarbital, oxazepam, secobarbital sodium, estazolam, lorazepam, clonazepam, alprazolam, diazepam, and triazolam by UHPLC with PDA detection (889); analysis of alprazolam, estazolam, clonazepam, diazepam, phenobarbital, midazolam maleate, triazolam, nitrazepam, barbital, secobarbital, chlordiazepoxide, lorazepam, amobarbital, and oxazepam by UHPLC with PDA detection (890); analysis of mephedrone, 5,6-methylenedioxy-2-aminoindane (MDAI), and MDMA by SERS on copper coins coated with deposited silver (891); detection of 6 chemical constitutes illegally added into health foods for dieting by UPLC-MS/MS (only sibutramine HCl and phenolphthalein were identified in the abstract) (892); identification of undeclared synthetic drugs (ranitidine, orphenadrine citrate, piroxicam, and dexamethasone) in medicines illegally sold as phytotherapies by diffusion-ordered NMR spectroscopy and

HPLC-UV-SPE-NMR (893); the longterm stability of 4-MEC, MDAI, methoxetamine, 5-MeO-DALT, 6-APB, MPA, 5-IAI, MDAT, 2-AI, AMT, 25C-NBOMe, AH-7921, 5-MAPB in blood and plasma, as determined by HPLC/DAD, LC-MS/MS, and UHPLC-Q-TOF-MS (894); determination of dextromethorphan and levomethorphan in heroin by enantioselective HPLC and electronic CD (895); identification of sibutramine HCl, fenfluramine HCl, phenolphthalein, strychnine, ephedrine HCl, and hydrochlorothiazide in health foods with weight reducing properties by TLC and HPLC-MS/MS (896); a survey of 449 "legal highs" seized in Poland between mid-2008 and mid-2011 (including MPDV, caffeine, butylone, TFMPP, lidocaine, 4-MEC, mephedrone, pFPP, BZP, and MDPBP, and others) (897);

2014 analysis of 4-fluoroamphetamine, methiopropamine, ethcathinone, 4-methylethcathinone, N-ethylbuphedrone, ethylphenidate, 5-MeO-DALT, dimethocaine, 5-(2-aminopropyl)benzofuran, and nitracaine by a Selective Reagent Ionisation-TOFMS (898); trends in Irish street-level heroin and cocaine 2010-2012 (899); terahertz detection of ketamine and ATSs (900); an overview of the presence of mephedrone, 4-methylethcathinone, BZP, MDPV, TFMPP, methoxetamine, 4-fluoromethcathinone, 4-methylamphetamine, PMA, methylone, PMMA, naphyrone, alpha-methyltryptamine, butylone, MDAI, desoxypipradrol, D2PM, MPA, synthetic cannabinoids, 2-AI, 5-IAI, 5-MeODALT, MDPBP, 5/6-APB, pentedrone, and pentylone in post-mortem and criminal casework (toxicological focus) (901); analysis of 2-aminopropyl-benzofuran with 4 potential positional isomers, methiopropamine, and 2-(ethylamino)-1-(4-methylphenyl)pentan-1-one by GC/MS and NMR (902); analysis of alprazolam and fluoxetine by UV/Vis (903); a review on detecting residues of chlorpromazine and diazepam in foods (904); identification of ephedrine, caffeine, furosemide, fenfluramine, phenolphthalein, sibutramine, N-desmethyl sibutramine, and N-didesmethyl sibutramine in weight controlling health food by UHPLC/DAD (905); analysis of bromazepam, flunitrazepam, fluoxetine hydrochloride, clozapine, and risperidone by TLC (906); analysis of cocaine, LSD, levamisole, papaverine, and others by MALDI-HRMS, HPLC/DAD, and Quad-MS (907); analysis of cocaine, heroin, methamphetamine, oxycodone, and amphetamine on currency by LC/MS (908); syntheses, characterization, and in vitro metabolism of nitracaine, methoxypiperamide and mephtetramine (909); analysis of MDMA and mCPP by CE (910); determination of the stability in solution of 4-MEC, MDAI, methoxetamine, 5-MeO-DALT, 6-APB, MPA, 5-IAI, MDAT, 2-AI, AMT, 25C-NBOMe, AH-7921, and 5-MAPB by HPLC-DAD, LC-MS/MS, and UHPLC-Q-TOF-MS (911); analysis of amphetamine, methamphetamine, MDMA, N,N-dimethylamphetamine, PMA, PMMA, BZP, TFMPP, mCPP, and MeOP by DESI-MS (912); analysis of 3-methylmethcathinone, methylone, butylone, 4-methylethcathinone, flephedrone, methylenedioxypyrovalerone, pentedrone, methoxetamine, APINACA, AKB48, benzydamine, meta-chlorophenylpiperazine, 5-MeO-DALT, 5-MeOMIPT, 6-APB, 4-APB, diphenidine, and others, by single quadrupole GC/MS, positive ESI-LC/HRMS, and NMR (913); determination of lidocaine, ketamine, and diazepam in foodstuffs using micellar LC (914);

analysis of amphetamine, methamphetamine, caffeine, paracetamol, and theophylline by HPLC (915); identification of the piperazine derivative MT-45 (I-C6), the synthetic peptide Noopept (GVS-111), the synthetic cannabinoid A-834735, 4-methoxy-α-PVP, and 4-methylbuphedrine (analytical methodologies not provided in the abstract) (916); analysis of FUB-PB-22, 5-fluoro-NNEI indazole analog (5-fluoro-MN-18), AM-2201 indazole analog (THJ-2201), XLR-12, 5-fluoro-AB-PINACA, 5-chloro-AB-PINACA, AB-CHMINACA, and 5-fluoro-AMB; DL-4662, α-PHP, 4-methoxy-α-POP, 4-methoxy-α-PHPP, and 4-fluoro-α-PHPP; 2-(2-ethylaminopropyl)-benzofuran (2-EAPB), nitracaine, diclofensine, diphenidine, 1-benzylpiperidine, and acetyl-fentanyl (analytical methodologies not identified in the abstract) (917); analysis of mixtures of methamphetamine, MDMA, and ketamine by GC/MS and GC/FID (918); **2015** analysis of dextromethorphan, 2-aminoindane, and lidocaine using handheld NIR, Raman, and FTIR/ATR instruments (919); examination of "third hand smoke" from cocaine and methamphetamine as a source of recoverable trace evidence (920); detection of cocaine and ketamine by paper micro-fluidic devices (921); qualitative, quantitative, and temporal study of cutting agents for cocaine and heroin confiscated in western Switzerland from 2006 to 2014 (analytical methodologies not identified in the abstract) (922); detection of cocaine, phytocannabinoids, nicotine, caffeine, and others in the air by collection on filters with analysis by GC/MSD (923); detection of nicotine, caffeine, cocaine, cannabinol, cannabidiol, and THC on particulates in indoor air (analytical methodology not identified in the abstract) (924); trends from 2002 to 2013 in the diversion and abuse of oxycodone, hydrocodone, hydromorphone, fentanyl, morphine, and tramadol (925); validation of a GC/FID for the quantitation of cocaine and heroin (926); analysis of various NPSs, including "Synthacaine" (purported to be a mixt. of methiopropamine (MPA) and dimethocaine, but instead containing MPA and benzocaine), two positional isomers of (2-amino-propyl)-benzofuran (5-APB and 6-APB), 2-amino-1-(4-bromo-2,5-dimethoxyphenethyl)ethanone (bk-2C-B), and 2-(ethylamino)-1-(4-methylphenyl)-pentan-1-one (MEAP) (analytical methodologies not identified in the abstract) (927); analysis of two component mixts. of morphine-papaverine and acridine-papaverine by TLC-IMS (928); identification of brodifacoum, black tar heroin and its impurities (morphine, codeine, noscapine, papaverine, and monoacetyl-morphine), crack cocaine, and 1-methylaminoanthraquinone by an atmospheric solid analysis probe interfaced to a linear ion trap-MS (929); analysis of 25H-NBOMe, 25D-NBOMe, 25E-NBOMe, 25I-NBMD, RH34, escaline, 5-DBFPV, 3,4-MDPHP, 3,4-dimethyl-NEB, 3,4-dimethyl-α-ethylaminopentiophenone, 3,4-dimethyl-α-PVP, 4F-α-ethylaminopentiophenone, bk-IVP, bk-IBP, MMXE, 25INBOMe, ADB-CHIMINACA, 5F-ADB, and butane-1,4-diol by GC/MS, HRMS, and NMR (930); determination of amphetamine, cocaine, methadone, diazepam, methylphenidate, oxazepam, tramadol, morphine, buprenorphine, and 6-monoacetyl-morphine by SERS (931); determination of 22 drugs of abuse and transformation products in airborne particulate matter by pressurized liquid extraction followed by LC-MS/MS (cannabinol, cocaine, and methamphetamine were the most abundant compds; the other 18 cmpds were not identified in the abstract) (932); detection of THC, methamphetamine, and amphetamine at low

ppb level in air using a field asymmetric IMS microchip sensor (933); use of paper microfluidic devices for presumptive identification of cocaine, opiates, ketamine, various phenethylamines, and others (934); detection of phytocannabinoids, cocaine, lidocaine, and nicotine by ESI-FT-ICR-MS (with comparison against the fast blue B colorimetric test (935); use of fluorescent d10 metal complexes for the presumptive identification of cocaine, PCP, diphenhydramine, and benzylpiperazine (936); determination of benzodiazepines and zolpidem in water samples (using polypropylene tubes as single-use and low-cost sorptive extraction materials) (937); determination of phentermine, phendimetrazine, phenmetrazine, fenfluramine, benfluorex, mephentermine, fencanfamine, sibutramine, sildenafil, vardenafil, and tadalafil in food supplements by LC-HR-MS (938); analysis of venlafaxine, escitalopram, fluoxetine, candesartan, risperidone, trihexyphenidyl, thioridazine, aripiprazole, and trifluoperazine by UHPLC (939); a review of the published voltammetric and potentiometric methods developed for determination of dextromethorphan and diphenhydramine (940); analysis of FDU-NNEI, AB-CHMINACA, MN-18, N-OHEDMA, dimethoxy-α-PHP (analytical methodologies not identified in the abstract) (941); analysis of methamphetamine, morphine, and codeine by a probe ESI-MS with a discontinuous atmospheric pressure interface (942); determination of barbital, phenobarbital, chlormezanone, amobarbital, zopiclone, melatonin, chlorphenamine maleate, clozapine, zaleplone, zolpidem tartrate, oxazepam, nitrazepam, triazolam, clonazepam, midazolam maleate, diazepam, and olanzapine in traditional Chinese medicines and health foods by HPLC (943); determination of carbamazepine, doxepin, diazepam, lorazepam, amitriptyline, temazepam, oxazepam, and alprazolam in an urban water system (analytical method not identified in the abstract) (944);

2016 use of screen-printed electrodes for quantification of cocaine and THC (945); the persistence of illicit drug smoke residues from cocaine and methamphetamine and their recovery from common household surfaces (946); chemical profiling of cocaine and heroin as a tool to decipher the structure and organisation of illicit drug markets (947); a review of the cutting of cocaine and heroin (948); analysis of mephedrone and MDAI by microcrystalline testing and Raman microspectroscopy (949); use of a fluorescence probe for ketamine and methamphetamine detection without pretreatment (950); IMS response of cocaine, heroin, methamphetamine, MDMA, and THC against environmental background levels (951); the vaporization enthalpy and vapor pressure of fenpropidin and phencyclidine (PCP) at T/K = 298.15 by correlation GC (952); simultaneous determination of morphine and naltrexone by HPLC (953); analysis of 5-MAPDB, 5-AEDB, MDMA methylene homolog, 6-Br-MDMA, and 5-APB-NBOMe by LC-QTOF-MS, GC/MS, and NMR (954); sorption of ionized pharmaceutical and illicit drugs to a mixed-mode coated microsampler, including amphetamine, amitriptyline, promazine, chlorpromazine, trifluprom azine, difenzoquat, 8 basic pharmaceutical and illicit drugs (MDMA, atenolol, alprenolol, metoprolol, morphine, nicotine, tramadol, verapamil, 3 neutral benzodiazepines (diazepam, temazepam, and oxazepam), and diclofenac (955); analysis of a mixt. of cocaine, MDA, and MDMA by single analyzer precursor scanning using an ion trap (956); analysis of the

phenethylamine derivative 2-(4-iodo-2,5-dimethoxyphenyl)-N-[(3,4-methylenedioxyphenyl)-methyl]ethanamine (25I-NB34MD) and the piperazine derivative 1-(3,4-difluoromethylene-dioxybenzyl)piperazine (DF-MDBP) by LC/MS, GC/MS, HRMS, and NMR (957).

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

2. Instrument Focus

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

2.A - Polydrug B: Mixed or Unrelated Groups of Compounds or Substances Named Groups of Compounds: 2013 analysis of 277 "selected" synthetic cannabinoids and cathinones, amphetamines, natural cannabinoids, opioids, cocaine and other "important drugs of abuse" by UHPLC-HR-TOFMS (toxicological focus) (958); analysis of cathinones, phenethylamines, tryptamines, and piperazines by LCQQQ-MS/MS in the MRM mode (toxicological focus) (959); **2014** analysis of various phenethylamines, cathinones, synthetic cannabinoids, and tryptamines by IMS (compounds not identified in the abstract) (960); an overview and literature review of synthetic cannabinoids and synthetic cathinones (961); a review of the analysis of (unspecified) "psychostimulants" by TLC (962); qualitative analysis of 34 synthetic cannabinoids and synthetic cathinones by GC-triple quadrupole-MS/MS (963); screening and identification of cathinones, synthetic cannabinoids/cannabimimetics, and phenethylamines by UHPLC with DAD and MS detection (964); a review of the analysis of of (unspecified) "anesthetics" by TLC (965); identification of 61 different psychoactive substances (predominantly substituted phenethyl-amines, cathinones, tryptamines and synthetic cannabinoids) by LC-chemiluminescence-nitrogen detection (966); analysis of morphine and a series of adrenergic phenolic amines (not identified in the abstract) by chemiluminescence detection on 3D-printed and CNC milled flow-cells (967); crossreactivity of 24 phenylethylamines (including 8 cathinone derivatives), 3 piperazines, and 3 tryptamines in commercial enzyme-linked immunosorbent assays (968); chiral analysis of seven benzo-furys, four cathinones, two diphenidines, ethylphenidate, methiopropamine, and thiothinone by CE (969); an overview of the appearance and evolution of cannabimimetics and cathinones (970); **2015** characterization of 25INB2OMe, 25I-NB3OMe, 25I-NB4OMe, 25I-NB2B, 25I-NB3B, 25I-NB4B, their 5-methoxytryptamine counterparts, and 6 meta-substituted N-benzyl derivs. of 5-methoxytryptamine (CF3, F, CH3, Cl, I, SCH3), by GC/ion trap-MS in both EI and CI modes, LC/DAD, IR, ESI-QTOF-MS/MS, and Triple-Quad-MS/MS (971); analysis of 11 phenethylamines and cathinones by 1H-NMR, COSY, TOCSY, and DOSY

(972); an overview of synthetic cannabinoids and designer cathinones (973); regioisomeric and enantiomeric analyses of 24 designer cathinones and phenethylamines using UHPLC and CE with added cyclodextrins (compounds not identified in the abstract) (974); a review of the detection methods (including covering colorimetric detection, immunochem. assays, GC/MS analyses, and LC/MS) for synthetic cannabinoids and cathinones (975); cross-reactivity of 2,5-dimethoxyamphetamines, "2C" cmpds (2,5-dimethoxyphenethylamines), β-keto amphetamines, substituted amphetamines, piperazines, α-pyrrolidinopropiophenones, tryptamines and PCP analogs on five commercial immunoassay screening kits (976); **2016** separations of barbiturates, sulfonamides, nucleic bases, and nucleosides on polymethacrylate zwitterionic monolithic micro-columns in 2D-LC (977);

Abused Substances Illegally Added to Licit Pharmaceuticals, Herbal Medications, Health Supplements, and Foodstuffs (Notes: A) Specific, named compounds are compiled in their individual categories above; B) There are many dozens/hundreds of highly repetitive articles pertaining to adulteration of Chinese foods, food seasonings, health care supplements, sexual enhancement aids, Chinese Traditional Medicines, etc.; only a select six of these are included below): 2012 analysis of for anorexigenic, benzodiazepinic, and antidepressant drugs in phytopharmaceuticals by GC/MS (978); **2013** detection of undeclared synthetic drugs in traditional herbal medicines, using LC-MS/MS, GC-MS/MS, and similar techniques (979); standardless 1H-NMR determination of a "wide range of" pharmacologically active substances in dietary supplements and medicines (only mesterolone is specifically mentioned in the abstract) (980); **2014** detection of 35 illegally added steroid compounds in foods and dietary supplements by LC-MS/MS (981); detection of 29 weight loss compounds in foods and dietary supplements by LC-MS/MS (982); a review of the determination of pharmacologic adulterants in herbal-based pharmaceuticals by CE (983); rapid identification of 22 drugs illegally added into sleep-improving health foods by UHPLC-TOF-MS (984); **2015** simultaneous analysis of 28 narcotic adulterants (not identified in the abstract) used in dietary supplements by LC-MS/MS (985); analysis of 24 sedative-hypnotic drugs (not identified in the abstract) illegally added into health foods, by UPLC-ESI-QTOF/ MS (986); screening of 24 sedative hypnotics illegally added to "improving sleep" health foods by HPLC-ion trap-MS (987); determination of 36 chemicals added into traditional Chinese medicines and health care products by UPLC-MS/MS (988); substitute reference substance and secondary mass spectral libraries for rapid screening of sedative hypnotic drugs illegally added to Chinese drugs and health products by HPLC-DAD and HPLC-MS/MS (989); an overview and review of alkaloids in foods (990); determination of caffeine and adrenergic stimulants in food supplements by HPLC/DAD (991); identification of chemical substances illegally adulterated in traditional Chinese medicines and health foods by physico-chem. anal., TLC, HPLC, LC/MS, GC/MS, CE, ion mobility chromatog., IR, NIR, Raman, and LC-MS/MS (992); **2016** a comprehensive strategy to detect the fraudulent adulteration of herbs by FTIR and chemometrics, as well as LC-HRMS

(993); direct determination of 42 chemical drugs illegally added in herbal medicines and dietary supplement by HPLC-Quadrupole-electrostatic field Orbitrap-HRMS (994); an overview of regulation of dietary supplements in the U.S. and issues of adulteration with phenethylamines (995); detection of low molecular weight adulterants in beverages by DART-MS (996); an overview and review of the adulteration of herbal sexual enhancers and dieting aids (997);

Abused Drugs and Pharmaceuticals in Surface Waters and Municipal Wastewater Streams:

[Note: Each year in this subsection is separated by a line space.]

2012 analysis of sewage in the Brazilian Federal District as a means for estimating cocaine consumption (analytical method not specified in the abstract) (998);

2013 a study of the uncertainty associated with the estimation of community illicit drug consumption via analysis of sewage (999); analysis for mephedrone, methylone, MDPV, BZP, TFMPP, methcathinone, and MDMA in sewage in Adelaide, Australia, by SPE-LC-MS/MS (1000); a review of drugs of abuse in waters and wastewaters: occurrence, analysis, and forensic applications (1001); detection of of pharmaceuticals and "food additives" in sewage by SPE-LC-MS/MS (1002); by online-SPE-LC/MS (1003); analysis for 25 different drugs in wastewater by solid phase extraction and GC/MS (1004); detection of of illicit drugs in wetlands water by LC/MS (1005); analysis of wastewater in Finland for abused drugs and opioids, using SPE and LC-MS/MS (1006);

2014 identification and quantification of trace concns. of pharmaceuticals (caffeine, prazosin, enalapril, carbamazepine, nifedipine, levonorgestrel, simvastatin, hydrochlorothiazide, gliclazide, diclofenac-Na, and mefenamic acid) in surface waters, by LC-TOF/MS (1007); removal efficiencies of cocaine, amphetamine, methamphetamine, THC-COOH, benzoylecgonine, MDMA, ketamine, heroin, and other drugs at a wastewater treatment plant (analytical methodology not identified in the abstract) (1008); determination of stimulants, hallucinogens and their metabolites, opioids, morphine derivs., benzodiazepines, antidepressants, and others in wastewaters in England (analytical methodologies not identified in the abstract) (1009); population normalization using ammonium in wastewater-based epidemiology, and its application to illicit drug monitoring (benzoyl ecgonine, THC-COOH, cocaine, and 4-hydroxy-3-methoxymethamphetamine are named in the abstract) (1010); use of a cavitand-grafted silicon microcantilever as a universal probe for illicit and designer drugs in water (1011); determination of amphetamines, MDMA, cocaine, opioids, cannabis, and ketamine, and their major metabolites, in urban wastewaters by UHPLC-MS/MS (1012); determination of 1525 micro-pollutants and transformation products in wastewater by LC-QTOF-MS with an accurate-mass

database (1013); survey of the occurrence of pharmaceuticals in Spanish drinking waters (1014); highly sensitive determination of 68 psychoactive pharmaceuticals, illicit drugs, and related human metabolites in wastewater by LC-MS/MS (1015); screening of illicit and licit drugs in waters in Colombia by LC-QTOF-MS (1016); determination of 21 acidic pharmaceuticals and personal care products in the Turia River Basin, Spain by LC/MS-MS/ESI-NI (1017); a selection of papers from the first international multidisciplinary conference on detecting illicit drugs in wastewater (1018); evaluation of illicit and licit drug consumption based on wastewater analysis in Fort de France urban area (Martinique, Caribbean) (1019); determination of nalbuphine, naltrexone, morphine, and tramadol by a bromatometric assay (1020); a review of the analysis of chiral pharmaceuticals in the environment (wastewater) by chiral chromatography coupled with mass spectrometry (1021); a sampling method for detecting analgesics, psycholeptics, antidepressants, and illicit drugs in aquatic environments in the Czech Republic (1022); quantification of (unspecified) target drugs in different wastewater samples by a validated SPE/LC-MS/MS method (1023); the ecotoxicity and contribution to the environmental hazard of pharmaceuticals in hospital wastewater (1024); use of columns containing sand and undisturbed fine-grained sediments to simulate injection of wastewater contg. caffeine, methamphetamine, and acetaminophen into a septic system, leaky sewer, or landfill (1025); a review of the determination of pharmaceuticals and illicit drugs in waters by LC-HRMS (1026); communal assessment of drugs of abuse and identification of their transformation products by analysis of sewage/wastewater by online SPE-LC-HRMS (1027); estimation of illicit and pharmaceutical drug consumption estimated via wastewater analysis (1028); a review of the occurrence, effects, and methods for detection of antibiotics and illicit drugs in the environment (1029); determination of cocaine, benzoylecgonine, ecgonine methylester, methadone, 2-ethylidene-1,5-dimethyl-3,3-diphenylpyrrolidine, 6-monoacetylmorphine, amphetamine, methamphetamine, ecstasy, mephedrone, methylenedioxypyrovalerone, 11-nor-9-carboxy-delta-9-tetrahydrocannabinol, ketamine, and norketamine in sewage (analytical method not identified in the abstract) (1030); an overview of international management trend of pharmaceuticals and personal care products in water environments (1031); the transformation products of illicit drugs in the aquatic environment (1032); estimation of amphetamine and methamphetamine use through sewage-based analysis (1033); determination of pharmaceuticals and personal care products in a mesoscale subtropical watershed and their application as sewage markers (1034); comparison of illicit drug use in three selected towns in Slovakia by wastewater analysis (1035); identification of contaminants in water by UHPLC-QTOF-MS (1036); analysis for ethyl sulfate in raw wastewater for estimation of alcohol consumption and its correlation with drugs of abuse in the city of Barcelona, Spain (1037); an overview of organic contaminants in surface water and groundwater in Italy (1038); determination of amphetamines in wastewater by LC-MS/MS (1039); a discussion of the need to develop ethical guidelines for researchers using sewage epidemiol. to monitor drug use in the general population and in specific precincts, including prisons, schools, and workplaces (1040); determination of benzodiazepines, related pharma-ceuticals, and metabolites in water by SPE and

LC-MS/MS (1041); using biomarkers in wastewater to monitor community drug use (focus on NPSs) (1042); determination of over 400 priority and emerging pollutants in water and wastewater by SPE and LCTOF-MS (1043); removal efficiencies of amphetamine-type stimulants, cocaine and benzoylecgonine, opioids, codeine, MDA, fentanyl, dihydrocodeine, and heroin at each point of wastewater treatment (analytical methodology not identified in the abstract) (1044); determination of cocaine, benzoylecognine, propranolol, diclofenac, amitriptyline, carbamazepine, carbamazepine-epoxide, citalopram, metoprolol, carisoprolol, and sertraline in urban streams in Brazil (analytical methodology not identified in the abstract) (1045); systematic screening for common wastewater marking pharmaceuticals in urban aquatic environments (1046);

2015 occurrence and in-stream attenuation of wastewater-derived pharmaceuticals in Iberian rivers, Spain (1047); determination of 4 benzodiazepines (bromazepam, carbamazepine, diazepam, and nordiazepam) and 4 barbiturates (barbital, pentobarbital, phenobarbital, and secobarbital) in river water and wastewater using SPE followed by LC-(ESI)MS/MS (1048); screening for pharmaceuticals and illicit drugs in wastewater and surface waters of Spain and Italy by UHPLC-QTOF-MS and LC-LTQ-Orbitrap-MS (1049); determination of heroin and methadone in wastewater in Lausanne, Switzerland (analytical methodology not identified in the abstract) (1050); fast determination of 40 drugs in water (10 effluent wastewater and 10 surface water samples) using large volume direct injection LC-MS/MS (1051); determination of 10 synthetic cannabinoids, cathinones, piperazines and pyrrolidophenones in wastewater by LC-MS/MS (1052); determination of ketamine and mephedrone in wastewater in 17 cities in Italy, by SPE-LC-MS/MS (1053); methamphetamine and ketamine (analytical methodology not identified in the abstract) (1054); an overview and review of determination of contaminants in water by UHPLC/MS (1055); detection of cocaine and benzoylecgonine (and other drugs) in samples collected from three sewage treatment plants in Cyprus by off-line solid phase extn. followed by LC-MS/MS (1056); screening for more than 1,000 licit and illicit drugs and their metabolites in wastewater and surface waters from the Bogota, Colombia area by SPE followed by UHPLC-QTOF-MS (1057); detection of amphetamines, opioids, cocainics [sic], cannabinoids, lysergics, and their corresponding metabolites by SPE-LC-HR-MS (1058); advances towards a universal screening for organic pollutants in waters, by GC-QTOF-MS and LC-QTOF-MS (1059 and 1060); detection of illicit drugs in raw sewage influents by HRMS (1061); chemometric application of pharmaco-signatures in different aquatic systems (1062); determination of methoxetamine, butylone, ethylone, methylone, methiopropamine, PMMA, and PMA in sewage by LC-ESI-MS/MS (1063); the systematic and day-today effects of chemical-derived population estimates on wastewater-based drug epidemiology (1064); use of a Fenton-like reaction to remove illicit drugs and pharmaceuticals from wastewater (emphasis on methamphetamine and tramadol) (1065); determination of amphetamine and methamphetamine at 10 wastewater treatment plants by LC-HR-MS/MS (1066); detection of methamphetamine,

amphetamine, and codeine in wastewater (analytical methodology not identified in the abstract) (1067); analysis of pharmacologically active compounds in the environment by chiral LC-MS/MS (1068); detection of 4'-methyl-α-pyrrolidinohexanophenone (MPHP), 2-[4-(ethylsulfanyl)-2,5-dimethoxyphenyl]ethanamine (2C-T-2; Rosy), 4-methyl-5-phenyl-4,5-dihydro-1,3-oxazol-2-amine (4-MAR), and 1-(4-methoxyphenyl)-2-propanamine (PMA) in raw sewage by HR-MS (location not identified in the abstract) (1069); linking drugs of abuse in wastewater to contamination of surface and drinking water (17 drugs of abuse, including cocaine, several amphetamines, opioid drugs, and 2 metabolites, benzoylecgonine, and 2-ethylidene-1,5-dimethyl-3,3-diphenylpyrolidine (a metabolite of methadone) were investigated; analytical methodology not identified in the abstract) (1070); determination of alcohol and cocaine co-consumption in 2 European cities as assessed by wastewater analysis using LC-MS/MS (1071); wastewater-based epidemiology of stimulant drugs based on analysis of sewage samples from 42 European cities collected daily for one week in March, 2013 (1072); determination of 25 synthetic psychoactive compds., including amphetamine, sympathomimetic substituted amphetamines, synthetic cathinones, and ketamine, in raw wastewater, secondary effluent, and river water by SPE followed by LC-MS/MS (1073); comparison of wastewater analysis and population surveys for use of methamphetamine, MDMA, and cocaine (1074); determination of cocaine and benzoylecgonine in the Esmeraldas watershed in Ecuador (analytical methodology not identified in the abstract) (1075); comparison of population surveys with wastewater analysis for monitoring illicit drug consumption in Italy from 2010-2014 (1076);

2016 identification of "a wide range of suspected and unknown compds. in environmental samples" by LC-HRMS (1077); determination of the occurrence and spatial distribution of 158 pharmaceuticals, drugs of abuse, and related metabolites in offshore seawater by SPME and LC-MS/MS (1078); determination of pharmaceuticals in coastal systems using SPE and UPLC-MS/MS (1079); use of wastewater-based epidemiology to estimate consumption of methamphetamine, benzoylecgonine, MDMA, methadone, oxycodone, and hydrocodone (analytical methodology not identified in the abstract) (1080); analysis of illicit drugs in wastewater to assess the market share held by criminal groups (1081); determination of amphetamine, methamphetamine, MDMA, and cocaine in 7 locations in Belgium over 2011-2015 (analytical methodology not identfied in the abstract) (1082); validation and uncertainties evaluation of an isotope dilution-SPELC-MS/MS for the quantification of drug residues in surface waters (including diazepam and MDMA) (1083); determination of cocaine and benzoylecgonine in environmental samples by newly developed sorbent materials (1084); detection of opioid analgesics, amphetamines, cocaine, heroin, stimulants, anesthetics, sedatives, anxiolytics, designer drugs, phosphodiesterase-5 inhibitors, and amphetamine and methamphetamine drug precursors in wastewaters by LC-MS/MS (1085); quantitative analysis of morphine, oxymorphone, hydromorphone, oxycodone, hydrocodone, and THC-COOH in river and wastewater by UHPLCMSMS with an API/ESI source (1086); source discrimination of drug

residues in wastewater by chiral LC-MS-MS (a case study) (1087); determination of drugs of abuse and alcohol consumption through sewage-based epidemiology among different groups of population on the Greek Island of Lesvos (1088); screening for drugs of abuse in the wastewater in a small college town in Southern Arkansas by GC/MS, GC/FID, and HPLC/MS (1089); screening for NPSs in urban wastewater using HRMS (1090); evaluation of sampling plans for cocaine, methamphetamine, MDMA, and methadone in wastewater (1091); wastewater based epidemiology in Finland (samples analyzed by UHPLC-MS/MS) (1092); estimation of drug abuse in 9 Polish cities by wastewater analysis by HPLC-MS/MS (1093); determination of heroin, cocaine, amphetamine, MDMA, methamphetamine, cannabis, codeine, and methadone in 6 Croatian cities (analytical methodology not identfied in the abstract) (1094); correlated results from an Australia-wide wastewater monitoring of cocaine/benzoylecgonine, methamphetamine, and MDMA (analysis by LC-MS/MS) (1095); determination of cocaine, MDMA, and methamphetamine residues in wastewater by LC/MS (1096); common illicit drugs (primarily methamphetamine and ketamine and their metabolites in surface waters) (analytical methodology not identified in the abstract) (1097); removal of psychoactive pharmaceuticals and illicit drugs from wastewaters by zerovalent iron and iron(VI) (1098); determination of cocaine, benzoyl-ecgonine, ephedrine, MDMA, methadone and its metabolite EDDP in Spainish river basins by online SPE-LC-ESI-MS/MS (1099); a review on the stability of illicit drugs in sewers and wastewater samples (1100); analyses for 48 emerging pollutants, including 25 drugs of abuse and metabolites, 17 cytostatic drugs, and 6 iodinated contrast media, in tap water in Madrid, Spain by SPE and LCMS/ MS (1101); effects of time delay between sample collection and extraction of wastewater samples for amphetamine and opioid analysis (1102); quant. analysis of 33 cmpds in a Brazillian coastal zone., including cocaine and bezoylecgonine, by LC-MS/MS (1103); detection and quantification of various opioid compounds (primarily heroin and morphine) in urban wastewater in Cookeville, Tennessee by LC-MS/MS (1104); determination of cocaine, methamphetamine, MDMA, amphetamine, codeine, morphine, heroin, fentanyl, oxycodone, methadone, BZP, TFMPP, methcathinone, methylone, mephedrone, MDPV, alpha-PVP, PMA, 25C-NBOMe, 25B-NBOMe, 25I-NBOMe, and cannabis in Adelaide, Australia for up to 4 years between Dec. 2011 and Dec. 2015 (analytical methodology not identfied in the abstract) (1105); determination of metabolites of methamphetamine, cocaine, THC, and heroin by LC/MS (1106); determination of amphetamine-like compds., ketamine, cocaine, and opioids in North China (analytical methodology not identfied in the abstract) (1107); detection of cocaine in wastewater with DNA-directed immobilization aptamer sensors (1108);

"Novel Psychoactive Substances" (NPSs): 2013 a review of 1320 cases containing one or more of 26 synthetic cannabinoids, 12 designer stimulants, and 5 hallucinogenic-like drugs (1109); an overview of the New Zealand approach to regulated NPSs (1110); **2014** a study of the prevalence and correlates of NPS use amongst a group of regular Ecstasy users in Australia (1111); a review (1112); a review (1113); a report from the European Drug Emergencies

Network on their efforts to improve the knowledge of acute drug toxicity of recreational drugs and NPS (1114); an overview of the effects and risks associated with NPSs (toxicological focus) (1115); an overview of legislation against NPSs in Ireland (1116); identification of NPSs by FTIR, Raman, and GC-IR (1117); an overview of the emerging trends in the abuse of NPSs (1118); an overview (1119); detection and presumptive identification of NPSs by a portable NIR spectrometer (1120); the impact of new retail restrictions and product licensing on the regulated legal market for NPS products in New Zealand (1121); an overview of the high variability of active ingredients concentration, mislabelled preparations, and presence of multiple psychoactive substances in NPS products (1122); **2015** wide-range screening of NPSs by FIA-HRMS (1123); detection and characterization of NPSs by IMS (1124); a review (1125); a brief overview of recent trends (1126); rapid screening of 35 NPSs by IMS and DART-QTOF-MS (1127); a study on the prediction of bioactivity of NPSs (1128); detection of NPSs by SERS (1129); an overview of recent developments in the analysis of NPSs (1130); an overview of NPSs and their impact on forensic science (1131); an overview and review, covering years 2013-2015 (1132); **2016** a proposal for a new categorization of NPSs based on neurobiol. mechanisms of action (1133); an overview of how NPSs are studied, produced, marketed, and controlled (1134); screening for 221 NPSs by infrared and Raman (1135); a review on the screening for NPSs by LC coupled with low-and high-resoln. MS (covering PubMed-listed studies from Jan. 2014 to Jan. 2016) (1136); detection of NPSs in street samples by NIR and chemometrics (1137); an update on New Zealand's legal market for NPSs (1138); an overview of the pharmacology of stimulant and hallucinogen NPSs (1139); a brief overview of the NPS situation in Japan (1140); a brief overview of the analytical challenges posed by NPSs (1141);

"Hallucinogens", "Hypnotics" (and similar generic terms): 2013 editorial remarks against the global prohibition of psychoactive drugs (1142); **2014** a review of the non-medical use of dissociative drugs (1143); a review of the determination of of anxiolytics and sedatives by TLC (1144); **2015** sedative-hypnotic and anxiolytic effects of "lotus leaf alkaloid extract" (the exact species of lotus - there are many - was not identified in the abstract) (1145);

"Illicit Drugs" (including "Controlled Substances," "Drugs of Abuse," "Illicit Drugs," "Narcotics," "Seized Drugs," and similar generic terms): 2012 "drugs of abuse" by Raman (1146); use of spatially offset Raman to detect "illicit drugs" through opaque plastic containers, colored glass bottles, paper envelopes, and clothes (1147); a review on THz time-domain spectroscopy (including THz spectra for "drugs of abuse") (1148); detection of "drugs of abuse" using SERS (1149); application of handheld FTIR and Raman spectrometers for detection of "drugs of abuse" (1150); a review of the analysis of "seized drugs" by UHPLC and UHPLC-MS (1151); a short review of recent advances in analysis of "drugs" (and other substrates) by MS (1152); **2013** an evaluation of the results of impurity profiling of "illicit drugs" from different analytical methods and/or from different laboratories (1153); detection of trace amounts of "illicit

drugs" on surfaces by direct analyteprobed nanoextraction coupled to nanospray ionization-mass spectrometry (1154); detection of "drugs" concealed inside diffusely scattering packaging, including plastic, paper, and cloth, by spatially offset Raman (1155); analysis of "illicit drugs" by ambient pressure thermal desorption ionization MS (1156); rapid screening for 73 "toxic and harmful substances" in foods by UHPLC/MS, with sample cleanup using the QuEChERS system (1157); an overview and review of the analysis of "illegal drug products" (1158); the effects of solvents on the analysis of "drugs" by ESI-MS (1159); a review of the analysis of "law-evading and illegal drugs" using liq.-liq. extn. and GC/MS (1160); a review of CE and CEC methods used for analysis of "drugs" in biological matrices (1161); use of a supramolecular sensor array with two fluorescent receptors to detect "addictive OTC drugs" (1162); analysis of "seized drugs" by LC-ESI/ MS/MS and AP-MALDI-MS/MS, with comparisons of the two techniques (1163); detection of "illicit substances" and pharmaceutical counterfeits by nuclear quadrupole and magnetic resonance (1164); annual review of "banned substances" (sports doping focus) (1165); an overview of advanced analytical instrumentation and methods for "drugs of abuse" (toxicological focus) (1166); **2014** screening of textiles for "contraband drugs" using portable Raman spectroscopy and chemometrics (1167); an evaluation of the effectiveness of MS, IR, and portable Raman to analyze commonly encountered drug mixts., as well as "legal highs" (1168); screening of "drugs of abuse" using a commercial paper spray system (1169); detection of "abused drugs" by HPLC (1170); an overview of recent trends in the analysis of "emerging drugs of abuse" (1171); analysis of of designer drugs ("bath salts") by Raman and SERS (1172); a review of new designer "drugs of abuse" (1173); a quantitative structure-toxicity relationship of the aquatic toxicity for various "narcotic pollutants" using the norm indexes (1174); **2015** a comprehensive review of the pyrolysis of "drugs of abuse" (1175); analysis of "drugs of abuse" (naturally occurring psychotropic drugs and new designer drugs) by DART-MS (1176); use of diazonium ions for the presumptive testing of "narcotics" containing an activated aromatic ring (1177); screening for "illicit drugs" by direct-heating HSSPME with GC/MS (1178); identification of "abused drugs" by GC/FTIR (1179); an overview and review of "drugs of abuse" and their detection methodologies (1180); determination of "illicit drugs" and their metabolites on banknotes by methanol extn. followed by LC-MS/MS (1181); a review of alkylsilyl derivatization techniques in the analysis of "illicit drugs" by GC (GHB, amphetamines, opiates, and cannabinoids were mentioned in the abstract) (1182); indirect chiral separation of "new recreational drugs" by GC/MS using trifluoroacetyl-l-prolyl chloride (1183); **2016** results of the Trans European Drug Information (TEDI) project (results for cocaine, ecstasy, and amphetamine, plus comments on NPSs detected between 2008 and 2013) (1184); rapid identification of "seized controlled substances" and related compounds by MS/MS without chromatography (1185); screening of "drugs of abuse" using DART-MS (1186); "forensic drug" analysis by chemical derivatization followed by GC/MS and LC/MS (1187); a survey of the qual. distribution of "drugs of abuse" (mostly NPSs) confiscated in Italy between 2013 and 2015 (1188);

Pharmaceuticals/Counterfeits (with a focus on differentiation of legitimate versus counterfeit products, or for monitoring quality control for legitimate pharmaceutics; see also a significant number of citations concerning counterfeits under Phosphodiestrase-5 Inhibitors, above): 2012 a review of the detection of counterfeit medications by Raman (1189); **2013** a review of a paper-based test for screening for counterfeits (1190); a general overview of the chromatographic techniques used to characterize counterfeit and illegal pharmaceuticals (1191); an overview of chromatographic and spectroscopic counterfeit detection methods (1192); examination of tablet surfaces by Multimodal DESI-MS imaging to detect counterfeits (1193); detection of counterfeit medications with portable Raman (1194); analysis of pharmaceuticals by Raman (1195); a review on the detection of counterfeit medications, focusing on HPLC and MS, but also discussing color testing, TLC, GC, Raman, NIR, FTIR, and NMR, using antimalarial drugs and sildenafil as illustrative examples (1196); **2014** detection of counterfeit medications with Raman and NIR (1197); confirmational identification of pharmaceuticals via DART-TOF-MS (1198); an overview of pharmaceutical process validation of solid dosage form (1199); **2015** systematic chemical and packaging analysis of counterfeit medications to derive useful intelligence (1200); **2016** an analytical strategy for rapid identification of counterfeit medications (1201); a review of the identification of counterfeit medicines by chemometrics (1202); a comprehensive review on prevalence, detection, and prevention of counterfeit drugs (1203).

2.B - Instrument Focus

General Overviews and Reviews (and articles covering multiple techniques): 2014 an overview of forensic drug analyses, including an analytical road-map (1204); an overview of drug testing, covering chem. testing, chromatog., spectroscopy, CE, immunoassay, and IMS (1205); **2015** a review of miniaturized separation techniques for forensic drugs analysis (including CE, CEC, and nano-LC) (1206);

Color Testing: 2014 the effect of benzene ring substituents on the mechanism of Duquenois Levine test for (phyto-)cannabinoid detection (1207); detection of pharmaceuticals using paper analytical devices (embedded with various color-testing reagents) (1208); **2015** use of presumptive color tests for NPSs (abstract not available) (1209); the modernization of physical appearance and solution color tests using quantitative tristimulus colorimetry (1210);

Computerized Tomography (CT): 2015 dual-energy CT behavior of heroin, cocaine, and typical adulterants (1211); use of CT (and X-ray, ultrasound, and MRI) to detect body packing (1212);

Electrophoresis (and Related Techniques): 2013 determination of active ingredients and preservatives in pharmaceuticals by CZE (1213); a review of recent advances in electrodriven enantioseparations (listed applications include "pharmaceutical" and "forensic") (1214); **2014** separation of acidic drugs by CEC using both chlorinated and nonchlorinated polysaccharide-based selectors (1215); a comprehensive overview and review (1216); a review of the application of CE techniques in toxicological analysis (1217); a review of recent method developments and applications of CE/DAD to pharmaceuticals (1218); **2015** a review of electromigrative sepn. techniques in forensic toxicol. (1219);

Gas Chromatography: 2013 forensic applications of GC (1220); **2016** a review of the forensic potential of comprehensive 2D-GC (1221); cleanup of complex matrices (containing drugs) by QuEChERS followed by GC analysis (1222);

Hyperspectral Imaging: 2013 development of a handheld widefield hyperspectral imaging (HSI) sensor for standoff detection of explosive, chemical, and narcotic residues (stated applications include "locating production facilities of illegal drugs") (1223);

Infrared Spectroscopy: 2013 use of IR spectral imaging for drug quality control (1224); **2014** analysis of varied substrates by FTIR spectroscopic imaging (1225); use of a handheld near IR spectrometer for the classification of 140 different substances, including cocaine, heroin, oxycodone, diazepam, synthetic cathinones, and synthetic cannabinoids (1226);

Ion Chromatography: 2012 ion chromatographic analysis of pharmaceuticals to determine authenticity and adulteration (listed applications include "forensic analysis") (1227); **2014** a review of ion chromatography-mass spectrometry (1228);

Ion Mobility Spectroscopy: 2014 use of DESI-AP-IMS for drug detection (1229);

"Lab-on-a-Chip" (Microfluidics): 2011 the use of microfluidic platforms for solid form screening of pharmaceuticals by Raman (1230); **2013** an overview of "forensic drug analysis" by microfluidic devices (1231); **2014** enhancement of chemiluminescent detection in microfluidic systems, for anal. of a wide range of compds., including illicit drugs and pharmaceuticals (1232);

Liquid Chromatography: 2012 an overview of good laboratory practices for HPLC (1233); an overview of some of the most recent applications of hyphenated LC techniques for forensic analyses (1234); **2013** quantitative structure-retention relationships models for prediction of HPLC retention time of small molecules (1235); **2014** use of immobilized polysaccharide-based stationary phases for enantioseparation in normal versus reversed phase HPLC (1236); a review of the use of chiral supercritical fluid chromatography for analysis of pharmaceuticals and drugs

of abuse (1237); a review of HILIC, discussing the development, basic sepn. mechanisms, stationary and mobile phases, and summarizing its applications in several research fields (1238); **2015** a chemometric approach to improve the accuracy and precision of quantitation in 2D-LC with dual detectors and multivariate curve resolution (1239); simultaneous determination of hydrophobicity and dissociation constant for 161 drugs by gradient RP-HPLC/MS (1240); HPLC method development using structure-based database search, physico-chemical prediction, and chromatographic simulation (1241); **2016** automated screening of reversed-phase stationary phases for small-molecule separations using LC/MS (emphasis on LC) (1242); simulation of elution profiles under gradient elution conditions, with mismatched injection and mobile phase solvents (includes simulated sepns. of selected amphetamines) (1243);

Mass Spectrometry: 2012 the mass spectra of designer drugs (reference text) (1244); **2013** use of Desorption Electro-Flow Focusing Ionization of explosives and narcotics for ambient pressure mass spectrometry (the "narcotics" included cocaine; no others were listed in the abstract) (1245); a review of DART-MS (1246); a review of ultrasensitive MS of organic molecules (listed applications include "forensics") (1247); a review of ambient MS, including DESI, DART, and extractive ESI (listed applications include "forensic identification") (1248); an evaluation of standardized software for processing GC/MS data from different instruments (1249); the application of ultra-fast triple quadrupole LC-MS/MS for forensic analysis of "abused drugs" (1250); a review of DESI-MS (listed applications include "illicit drugs") (1251); evaluation and testing of an alternative search algorithm for compound identification using the Wiley Registry of Tandem Mass Spectral Data, MSforID (1252); mass spectrometry using Matrix Assisted Ionization in vacuum (1253); **2014** recent advances in forensic drug analysis by DART-MS (1254); **2015** a review of surfaceassisted laser desorption ionization (SALDI) MS for forensic analysis (1255); a review of forensic mass spectrometry (1256); a wide use target screening system for GC/MS (1257); a new quant. contained-electrospray process for ESI-MS (1258); the use of the partial least squares method to model the positive ESI response produced by small pharmaceutical molecules (1259); a review of the characterization of synthetic and natural product pharmaceuticals by functional group analysis using ESI-ion trap-MS (1260); the use of online chemistry databases to facilitate structure identification (1261); a review of identification criteria and complicating factors for drug confirmation by mass spectrometry (1262); **2016** a review of the applications of ambient mass spectrometry to forensic chemistry (1263); a review of DART-MS (1264); determination of trace palladium in chemical bulk drug by ICP-MS (1265); a review of DART-MS (1266);

Microextraction Techniques: 2013 a review of liquid phase micro-extraction (LPME) techniques used in analysis of Chinese traditional medicines (1267); a review (listed applications include forensic and pharmaceutical) (1268); **2015** a review of SPME techniques (1269); **2016** a review of coupling SPME with ambient MS (1270); a review of microextraction in forensic

toxicology (1271); an overview of microextraction techniques for illicit drug testing (1272);

Microscopy and Microscopic Instrumental Techniques: 2013 comparison between microcrystalline tests performed on microscope slides versus flat capillary tubes (1273); **2014** a review of developments in applications of FTIR microspectroscopy, covering 2005 to 2013 (1274); **2015** use of an FTIR/ATR microscope for detecting analytes in high-interfering matrixes and in products with unknown ingredients (illicit tablets, counterfeit tablets, and unknown powders) (1275);

Nuclear Magnetic Resonance Spectroscopy: 2013 tracking authentic pharmaceuticals by 2H- and 13C-NMR (1276); **2015** cocaine, MDMA, and "metilona" (possibly methylone?) by "No-D NMR" (i.e., without the use of deuterated solvents) (1277); an overview of a "crime-scene NMR laboratory" (1278); **2016** improving the performance of high-precision qNMR measurements by a double integration procedure (1279); a review of the use of quant. 1H NMR spectroscopy in drug discovery and development (including a review of the pertinent literature between 1963 and 2015) (1280);

Raman: 2013 Use of THz-Raman accessing molecular structure with Raman spectroscopy for enhanced chemical identification, analysis, and monitoring (especially for discrimination of polymorphs) (1281); **2014** deep Raman detection with 2D correlation analysis for elucidation of a subsurface component under thick powder or packed contents in a bottle (1282); **2016** a review of the applications of SERS in forensic science (1283);

Spectrophotometry: 2014 methods for evaluating the visual limits of color perception (a proposal to create common rules for constructing color test scales for visual colorimetric assays) (1284); the molecular electron ionization cross - section and λmax in the studies of activities of alkaloids (1285); **2015** defining optimal conditions of colors in 3D space in dependence on gamma values, illumination, and background color (1286); **2016** a review of derivative UV-Vis spectrophotometry (1287);

Stable Isotopes: 2011 forensic applications (reference text) (1288); **2012** a review of the forensic applications of IRMS (1289); **2013** a review of inter-laboratory comparability of stable isotope data (1290); an extensive review of the isotopic anatomies of molecules and minerals (1291); the use of carbon stable isotope ratios in drugs characterization (by IRMS) (1292); global isoscapes for δ18O and δ2H in precipitation (1293); **2014** spatial, seasonal, and source variability in the stable oxygen and hydrogen isotopic composition of tap waters throughout the U.S. (1294); **2015** precipitation isotope (δ18O) zones revealed in time series modeling across Canada and northern U.S. (1295); simple spreadsheet templates for the determination of the measurement uncertainty of stable isotope ratio delta values (1296); a review of IRMS for source

determination (1297);

Supercritical Fluid Chromatography: 2016 an evaluation of innovative stationary phase ligand chemistries and analytical conditions for the analysis of basic drugs by SFC (1298);

Thin Layer Chromatography (and similar Planar Chromatographic Methods): 2013 an overview, including "forensic applications" (1299);

"Vibrational Spectroscopy" (Raman, mid-, near- and far-IR, and THz Spectroscopy): 2012 a review of the use of IR spectroscopy, terahertz spectroscopy and Raman spectroscopy in forensic sciences (1300); a review of sampling techniques for Raman, mid-, near- and far-IR, and THz spectroscopy (1301);

X-Ray Techniques: 2013 the use of energy dispersive X-ray diffraction (ED-XRD) spectra of drugs (and explosives) to detect "body packing" (1302);

Other: 2012 trace determination of metals (copper, zinc, nickel, cobalt, iron, arsenic, antimony, bismuth, vanadium, molybdenum, selenium, and lead) in drugs and pharmaceuticals as N-phenyl[1,2 methane fullerene C60]C61 complexes (1303); **2013** the use of gamma detectors in explosives and narcotics detection systems (1304); a review of microfluidic paper-based analytical devices and micro total analysis systems (1305); the utility of cyclodextrins in analytical chemistry (1306); **2014** a review of the use of acidic potassium permanganate as a chemiluminescence reagent (1307); the use of a chiral diffraction grating to measure the enantiomeric excess of a chiral compound (1308); the application of UV laserinduced solid-state fluorescence spectroscopy for characterization of solid dosage forms (1309); **2015** a review of miniaturized separation techniques (1310); a review of the pyrolysis of drugs of abuse (1311); an overview of emerging hyphenated SEMEDX (scanning electron microscopy with energy dispersive X-ray spectroscopy) and Raman spectroscopy systems (1312); a review of capacitively coupled contactless conductivity detection (1313); **2016** a review of enhanced performance separations, covering papers published in *Analytical Chemistry* from late 2014 through May 2016 (1314).

3. Miscellaneous Topics

Abuse Deterrent Formulations (see also numerous, specific examples under oxycodone and opiates): 2013 an overview of prescription drug abuse and the need for abuse deterrent formulations (1315); **2014** development and impact of prescription opioid abuse deterrent formulation technologies (1316); the use of prescription opioids with abuse-deterrent technology to address opioid abuse (1317); a review of extended release hydrocodone (1318); the U.S. FDA draft guidance for developing abuse-deterrent opioid analgesics (1319); an overview of anti-drug-abuse measures, including abuse-deterrent formulations (1320); an overview of methods used to reduce abuse potential of commonly abused pharmaceuticals (1321); **2015** an overview of the advance in the R&D of abuse-deterrent opioid analgesics (1322); an overview of abuse-deterrent formulations in countering opioid misuse and abuse (1323); an overview and review of abuse-deterrent formulations (1324); **2016** a comparison of the effectiveness of abuse-deterrent formulations of oxymorphone and oxycodone extended-release drugs (1325); a review and assessment of the potential impact of abuse-deterrent formulations of prescription opioid analgesics (1326); an overview of prodrug technology and its application for developing abuse-deterrent opioids (1327); a review (1328); an assessment of extended release abuse deterrent formulations (1329);

Anions and Cations: 2016 a review of the simultaneous separation of cations and anions by CE (1330);

Bacteria: 2014 recovery and identification of bacterial DNA from heroin and methamphetamine (1331); **2016** a discussion of a recent increase in drug abusers in Scotland who have presented with Staphylococcus aureus bacteremia with life-threatening complications due to their injection of NPSs (1332); the use of microbe analyses for forensic and criminal investigations (1333);

Canines: 2014 the efficacy of drug detection by fully-trained police dogs varies by breed, training level, type of drug and search environment (1334); treatment and prevention of acute poisoning of drug dogs caused by exposure to methamphetamine, ketamine, and MDMA (1335); **2015** a review of the advances in the use of odor as forensic evidence through optimizing and standardizing instruments and canines (1336);

Clandestine Laboratories - Appraisals and Safety: 2014 an update on the hazards and health effects assocd. with clandestine drug laboratories (1337); an evaluation of the acute and chronic environmental effects of clandestine methamphetamine waste (1338); adsorption and desorption characteristics of methamphetamine, MDMA, and pseudoephedrine in soils (1339); an overview and discussion of home preparations of abused substances (1340); **2015** vehicle-mounted portable mass spectrometry for covert detection of clandestine methamphetamine laboratories

(1341); **2016** decontamination of personal protective equipment and related materials contaminated with toxic chemicals (1342);

Degradation of Drugs and Pharmaceuticals: 2014 a review of forced degradation and stability indicating studies of drugs (1343); determination of pharmaceutical impurities and degradation products by NMR (1344); **2015** analysis of degradation products from drugs by a rapid resolution LC-collision energy correlated-MS (1345); **2016** a stability-indicating UPLC-MS/MS assay for 1960's era pharmaceuticals in dosage forms (1346);

Education: 2013 use of forensic science to teach method development in undergraduate analytical laboratories (1347); the use of paper-based diagnostics with high school students to model forensic investigation and colorimetric analysis (1348); **2014** the use of forensic science and simulated crimes in a one-week long "Criminal Camp" to teach the theory and practice of basic concepts in chem., physics, medicine, and biol. (1349); using education to combat "chemophobia" (1350); a course for non-science majors at a college that looks at the chem. behind the crime itself, and the chem. behind the anal. of evidence from the crime (1351); a discussion for the need for forensic science programs to develop job-related skills in their students (1352); an overview of forensic science (1353); initiation and evolution of a forensic chemistry program (1354); the use of forensic chem.-themed activities to introduce fundamental concepts, such as the scientific method, to middle and high school students (1355); an overview of the chemistry behind forensic science (1356); use of presumptive and confirmatory tests using analogs of illicit drugs as an undergraduate instrumental methods exercise (using multiple color tests, GC-MS, and ATR-FTIR) (1357); utilizing the "CSI Effect" in chemistry instruction (1358); a discussion for the need, development, and implementation of an effective continuing forensic science education program (1359); a discussion of the need for robust and rigorous scientific research in academia based on need-based input from forensic practitioners who see the day-to-day issues in their laboratories (1360); an overview of the Forensic Science Education Programs Accreditation Commission's (FEPAC) accreditation program, the FEPAC stds., and the process involved in seeking FEPAC accreditation (1361); careers in forensic chemistry (1362); using The Poisoner's Handbook in conjunction with teaching a first-term general / organic / biochemistry course (1363); **2015** a universal internet-based prevention program for ecstasy and NPSs (for teenaged students) (1364); a discussion of the efforts to develop integrated forensic platforms that allow for the forensic investigation of human biol. traces, identification of illicit drugs, and the study of digital evidence (1365); a case study review of a problem based learning approach used to educate and train young forensic scientists through the use of six sigma investigative tools (using hydrolysis of cocaine to benzoylecgonine at various pHs as the teaching example) (1366); **2016** a performance task case study (misconduct) for teaching data analysis and critical thinking (1367); using a "Drug of the Week" approach to educate chemistry students about prescription drugs and their abuse (1368); use of a variety of small scenes using doll house

furniture to educate criminal justice majors (1369);

Immunoassays: 2014 a review of the practical aspects of immunoassays and their application in clin. chem. for anal. of medicines and drugs of abuse (1370); the use cheminformatics to predict cross reactivity of "designer drugs" to their currently available immunoassays (1371);

Impurities and Impurity Profiling: 2012 a review of detection techniques for trace pharmaceutical impurities (1372); **2013** an overview (1373); a review of impurities in pharmaceuticals (1374); comparison of CCC and prep-HPLC for separating minor impurities in drugs (1375); **2014** analysis of impurities in drugs by LC-MS (1376); an overview of impurity profiling of pharmaceuticals (1377); a compendium of techniques for the analysis of pharmaceutical impurities, including TLC, HPTLC, HPLC, UPLC, GC., flash chromatog., SFC, CE, MECC, UV/Vis, IR, NMR, MS, LC/MS, LC-MS/MS, LC/NMR, HPLC/DAD-MS, HPLC/DAD/NMR-MS, UHPLC-MS, UHPLC-MS/MS, and chemometrics (1378); analysis and impurity identification in pharmaceuticals (1379); an overview of the impurity profiling methods for pharmaceuticals per current U.S. Pharmacopoeia guidelines (1380); **2015** method development for impurity profiling using SFC and comparing 6 different stationary phases (1381); an overview and review of recent advances in pharmaceutical impurity profiling (1382); a review of impurity profiling of drugs since 2010 (1383); development of an achiral SFC method with UV and MS detection for impurity profiling of drugs (1384 and 1385); an overview and review of impurity profiling of pharmaceuticals (1386); a review of impurity profiling, covering TLC, HPLC, HPTLC, LC-MS-MS, LC-NMR, LCNMR-MS, GC-MS, and LC-MS (1387); a review of impurity profiling of drugs (1388); **2016** an analysis of ionic interactions when characterizing 9 different stationary phases for drug impurity profiling with SFC (1389);

Inhalants: 2015 an overview of the abuse of nitrous oxide (1390);

Labelling and Packaging: 2012 examination of counterfeit labels on pharmaceuticals by IR and Raman (1391); **2013** a study on the effects of common drug packaging materials on nondestructive detection of contents by Raman spectrometry (1392); **2014** quantitative analysis of torn and cut duct tape physical end matching (1393); detection of counterfeit blister packaging by FTIR and chemometric methods (1394); a review of the identification of stamp impressions, including by microscopy, computer-assisted artificial identification, and anal. methods (UV-Vis, fluorometry, IR spectroscopy, Raman spectroscopy, TLC, LC, GC, and MS) (1395); **2015** evaluation of drug packaging by DSC (1396); determination of ethylene dichloride in drug packaging material made of polyethylene dichloride by headspace GC/ECD (1397);

Legal Issues: 2014 a regulatory perspective on the abuse potential evaluation of novel stimulant drugs in the U.S. (1398); an effort to develop objective scientific methods to quantify and define

the important "substantially similar" structural parameter used in several laws (1399); **2015** a proposal for objective scientifically-derived measures of molecular structural similarity (1400);

Precursors: 2013 impurity profiling of sassafras oils by GC×GC-TOF-MS (1401); **2014** a brief overview of the precursors for drugs of abuse (1402); determination of safrole in ethanol extract of nutmeg (Myristica fragrans Houtt) using RP-HPLC (1403);

Quality Assurance: 2013 use of a software tool ("Drugs WorkBook") for the quantification of illicit drugs (1404);

Sampling Plans: 2013 a study of particle size of amphetamine, heroin, cocaine, and herbal cannabis and its influence on mass reduction (1405); a general sampling plan for the quant. instrumental anal. of heroin, cocaine, amphetamine, cannabis resin, MDMA tablets, and herbal cannabis (1406); a new sampling plan which focuses on sample heterogeneity (from ENFSI) (1407);

Sensors (Biological and Instrumental): 2013 a review of biological organisms as volatile compound detectors (stated applications include illicit drugs) (1408); **2014** assessing the potential of metal oxide semiconducting gas sensors for illicit drug detection markers (1409); use of a parasitic wasp as a biosensor for cocaine (1410); a review of biosensors in forensic analysis (1411); **2015** detection of illicit drugs by trained honeybees (1412);

Soil: 2012 forensic examination (reference text) (1413); **2014** by elemenatal analysis (1414); use of visible microspectrophotometry and FTIR/ATR for examination of soils for trace evidence (1415); **2016** protocols for soil examinations (1416);

Surveys of Drug Use: 2014 a comparative evaluation of whether computer survey technology improve reports on alcohol and illicit drug use in the general population (1417); an overview of 4 different systems utilized in Australia for monitoring drug use (1418); the use of internet snapshot surveys to enhance understanding of the availability of 2 NPSs (4-methylaminorex and 4,4'-dimethylaminorex) (1419); a survey of pharmacological cognitive enhancement among university students in the UK and Ireland who were abusing "smart drugs" (modafinil, methyl-phenidate, or Adderall) (1420); **2015** a measure of the "interest" in MDPV, methylone, 4-MEC, 4-HO-MET, MXE, 6-APB, AH-7921, and 3-MMC before and after its scheduling in Sweden (1421); an update on the Pistoia Alliance Controlled Substance Compliance Service Project (1422); a discussion and evaluation of the contents, the destinations, and the sources of 960 postal items seized by Swiss customs at the Swiss border between 2013 and 2014 (1423);

Other: 2013 collection of trace chemicals from diverse surfaces by use of strippable coatings

(1424); the practical relevance of pattern uniqueness in forensic science (1425); **2014** a review of resolution by fractional crystallization of diastereomeric salts (1426); determination of water in active pharmaceutical ingredients using ionic liquid HS-GC and two different detection protocols (not identified in the abstract) (1427); reducing the complexity of an agent-based local heroin market model (1428); the examination of trace physical evidence and artificial materials (1429); use of an online database of chemical compounds for the purpose of structure identification (1430); **2015** a discussion of the comparison processes and evaluation systems that form a forensic intelligence framework, advocating scientific decision criteria and a structured but flexible and dynamic architecture (1431); an overview of ingestion of illicit drugs by "parachuting" (1432); the use of DNA sequencing analyses of the fungal diversity found in dust samples for geo-sourcing (1433); an assessment of the toxicity of the refill liquids for electronic cigarettes (based on the presence of microorganisms, diethylene glycol, ethylene glycol, hydrocarbons, ethanol, aldehydes, tobacco-specific nitrosamines, and solvents) (1434).

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