

Tobacco in Australia

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Relevant news and research

12.2 Measuring cigarette smoke constituents

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Research:

Braun, M, Al-Qaysi, R, Klingelhofer, D, Muller, R, & Groneberg, DA. (2020). High Particulate Matter Burden of Cigarettes from the United Arab Emirates and Germany: Are There Country-Specific Differences? *Int J Environ Res Public Health*, 17(7). Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/32252343>

Graves, BM, Johnson, TJ, Nishida, RT, Dias, RP, Savareear, B, Harynuk, JJ et al. (2020). Comprehensive characterization of mainstream marijuana and tobacco smoke. *Sci Rep*, 10(1), 7160. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/32345986>

Pack, EC, Kim, HS, Lee, SH, Koo, YJ, Jang, DY, Choi, SH et al (2020). Survey of characteristics of exposure to mainstream cigarette smoke using discarded cigarette butts from Korean smokers. *Environ Res*, 185, 109434. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/32276166>

Jurisch, M, de Paula, CCA, & Augusti, R. (2020). Distinguishing legal and illegal cigarettes by applying paper spray mass spectrometry and chemometric tools. *Rapid Commun Mass Spectrom*, e8752. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/32059068>

Li, C, Li, E, Ma, M, Liu, X, You, J, Wu, Y et al. (2020). Simultaneous determination of six alkaloids in tobacco and tobacco products by direct analysis of real-time triple quadrupole mass spectrometry with a modified pretreatment method. *J Sep Sci*. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/32034866>

Hawke, J, Errington, G, & von Frowein, MB. (2019). Evaluation of an online, real-time, soft-photon ionisation time-of-flight mass spectrometer for mainstream tobacco smoke analysis. *BMC Chem*, 13(1), 135. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/31891161>

Jones, J, Slayford, S, Gray, A, Brick, K, Prasad, K, & Proctor, C. (2020). A cross-category puffing topography, mouth level exposure and consumption study among Italian users of tobacco and

tobaccoinaustralia.org.au

Tobacco in Australia

Facts & Issues

nicotine products. *Sci Rep*, 10(1), 12. Available from:
<https://www.ncbi.nlm.nih.gov/pubmed/31913299>

Braun, M, Langenstein, A, Klingelhofer, D, Zulauf, N, Muller, R, & Groneberg, DA. (2019). Particulate matter emissions of less harmful-looking super-slim size cigarettes appealing to women: a laser spectrometric analysis of second-hand smoke. *Environ Sci Pollut Res Int*. Available from:
<https://www.ncbi.nlm.nih.gov/pubmed/31820227>

Pennings, JLA, Cremers, J, Becker, MJA, Klerx, WNM, & Talhout, R. (2019). Aldehyde and VOC yields in commercial cigarette mainstream smoke are mutually related and depend on the sugar and humectant content in tobacco. *Nicotine Tob Res*. Available from:
<https://www.ncbi.nlm.nih.gov/pubmed/31679033>

Sharifi, M, Donisa, C, & Joza, P. (2019). A Sensitive and Quantitative Isotope-Dilution LC-MS/MS Method for Analysis of Hydrazine in Tobacco Smoke. *J Chromatogr Sci*. Available from:
<https://www.ncbi.nlm.nih.gov/pubmed/31711231>

Zhang, L, Wang, L, Li, Y, Xia, Y, Chang, CM, Xia, B et al (2019). Evaluation of Tobacco Smoke and Diet as Sources of Exposure to Two Heterocyclic Aromatic Amines for the U.S. Population: NHANES 2013-2014. *Cancer Epidemiol Biomarkers Prev*. Available from:
<https://www.ncbi.nlm.nih.gov/pubmed/31575556>

Arndt, D, Wachsmuth, C, Buchholz, C, & Bentley, M. (2019). A complex matrix characterization approach, applied to cigarette smoke, that integrates multiple analytical methods and compound identification strategies for non-targeted liquid chromatography with high-resolution mass spectrometry. *Rapid Commun Mass Spectrom*. Available from:
<https://www.ncbi.nlm.nih.gov/pubmed/31479554>

Oladipupo, OA, Dutta, D, & Chong, NS. (2019). Analysis of chemical constituents in mainstream bidi smoke. *BMC Chem*, 13(1), 93. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/31384840>

St Helen, G, Benowitz, NL, Ko, J, Jacob, P, Gregorich, SE, Perez-Stable, EJ et al. (2019). Differences in exposure to toxic and/or carcinogenic volatile organic compounds between Black and White cigarette smokers. *J Expo Sci Environ Epidemiol*. Available from:
<https://www.ncbi.nlm.nih.gov/pubmed/31406274>

Ishizaki, A, & Kataoka, H. (2019). A sensitive method for the determination of tobacco-specific nitrosamines in mainstream and sidestream smokes of combustion cigarettes and heated tobacco

tobaccoinaustralia.org.au

Tobacco in Australia

Facts & Issues

products by online in-tube solid-phase microextraction coupled with liquid chromatography-tandem mass spectrometry. *Anal Chim Acta*, 1075, 98-105. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/31196428>

Lin, B, Chen, J, Zeng, Y, Li, L, Qiu, B, Lin, Z, & Guo, L. (2019). A facile approach for on-site evaluation of nicotine in tobacco and environmental tobacco smoke. *ACS Sens*. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/31250643>

Schwanz, TG, Bokowski, LVV, Marcelo, MCA, Jandrey, AC, Dias, JC, Maximiano, DH et al (2019). Analysis of chemosensory markers in cigarette smoke from different tobacco varieties by GCxGC-TOFMS and chemometrics. *Talanta*, 202, 74-89. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/31171230>

Sun, P, Yang, S, Sun, X, Wang, Y, Jia, Y, Shang, P et al. (2019). Preparation of PolyHIPE Scaffolds for 3D Cell Culture and the Application in Cytotoxicity Evaluation of Cigarette Smoke. *Polymers (Basel)*, 11(6). Available from: <https://www.ncbi.nlm.nih.gov/pubmed/31159508>

Zelinkova, Z, & Wenzl, T. (2019). Identification of cigarette brands by soft independent modelling of class analogy (SIMCA) of volatile substances. *Nicotine Tob Res*. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/31111907>

Zhang, P, Huang, Z, Ma, Y, Li, Y, Ali, N, Li, Q, & Chen, D. (2019). On-line detection of radioactive and non-radioactive heavy metals in tobacco smoke using portable laser-induced breakdown spectroscopy. *Analyst*, 144(11), 3567-3572. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/31062786>

Braun, M, Fromm, EL, Gerber, A, Klingelhofer, D, Muller, R, & Groneberg, DA. Particulate matter emissions of four types of one cigarette brand with and without additives: a laser spectrometric particulate matter analysis of secondhand smoke. *BMJ Open*, 2019. 9(1), e024400. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/30782733>

Cai, B, Li, Z, Wang, R, Geng, Z, Shi, Y, Xie, S et al. Emission level of seven mainstream smoke toxicants from cigarette with variable tobacco leaf constituents. *Regul Toxicol Pharmacol*, 2019. 103, 181-188. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/30710578>

Braun, M, Koger, F, Klingelhofer, D, Muller, R, & Groneberg, DA. Particulate Matter Emissions of Four Different Cigarette Types of One Popular Brand: Influence of Tobacco Strength and Additives. *Int J Environ Res Public Health*, 2019. 6(2). Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/30658514>

tobaccoinaustralia.org.au

Tobacco in Australia

Facts & Issues

Kim, YH, An, YJ, Jo, S, Lee, SH, Lee, SJ, Choi, SJ, & Lee, K. Comparison of volatile organic compounds between cigarette smoke condensate (CSC) and extract (CSE) samples. *Environ Health Toxicol*, 2018. 33(3), e2018012-2018010. Available from:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6182245/pdf/eht-33-3-e2018012.pdf>

Kaiser, S, Dias, JC, Ardila, JA, Soares, FL, Marcelo, MCA, Porte, LMF, Goncalves, C, Canova, LDS, Pontes, OFS, Sabin, GP. High-throughput simultaneous quantitation of multi-analytes in tobacco by flow injection coupled to high-resolution mass spectrometry. *Talanta*. 2018 Dec 1;190:363-374.

Available from: <https://www.ncbi.nlm.nih.gov/pubmed/30172520>

Verron, T, Julien, R, Cahours, X, Colard, S. Modeling of cigarette smoke constituents - From intense to less intense smoking regime. *Regul Toxicol Pharmacol*. 2018 Sep 15. pii: S0273-2300(18)30237-X.

Available from: <https://www.ncbi.nlm.nih.gov/pubmed/30227173>

Cuello-Nunez, S, Benning, J, Liu, C, Branton, P, Hu, J, McAdam, KG, Coburn, S, Braybrook, J, Goenaga-Infante, H. Fractionation of cadmium in tobacco and cigarette smoke condensate using XANES and sequential leaching with ICP-MS/MS. *Anal Bioanal Chem*, Aug 2018. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/30094791>

Zhang, X, Wang, R, Zhang, L, Ruan, Y, Wang, W, Ji, H, Lin, F, Liu, J. Simultaneous determination of tobacco minor alkaloids and tobacco-specific nitrosamines in mainstream smoke by dispersive solid phase extraction coupled with ultra-performance liquid chromatography-tandem orbitrap mass spectrometry. *Rapid Commun Mass Spectrom*, Jul 2018. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/29964303>

Chapman, GM, Bravo, R, Stanelle, RD, Watson, CH, Valentin-Blasini, L. Sensitive and selective gas chromatography-tandem mass spectrometry method for the detection of nitrobenzene in tobacco smoke. *J Chromatogr A*, 2018. Jun 11, 2018. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/29945789>

Hamad, SH, Johnson, NM, Tefft, ME, Brinkman, MC, Gordon, SM, Clark, PI, Buehler, SS. Little Cigars vs 3R4F Cigarette: Physical Properties and HPHC Yields. *Tob Regul Sci*. 2017 Oct;3(4):459-478.

Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29911130>

Krusemann, EJ, Lasschuijt, MP, de Graaf, C, de Wijk, RA, Punter, PH, van Tiel, L, Cremers, J, van de Nobelen, S, Boesveldt, S, Talhout, R. Sensory analysis of characterising flavours: evaluating tobacco

tobaccoinaustralia.org.au

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product odours using an expert panel. *Tob Control*. 2018 May 23. pii: tobaccocontrol-2017-054152.

Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29792305>

Goel, R, Bitzer, ZT, Reilly, SM, Foulds, J, Muscat, J, Elias, RJ, Richie, JP. Influence of Smoking Puff Parameters and Tobacco Varieties on Free Radicals Yields in Cigarette Mainstream Smoke. *Chem Res Toxicol*, Apr 2018. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29701955>

Inaba, Y, Uchiyama, S, Kunugita, N. Spectrophotometric determination of ammonia levels in tobacco fillers of and sidestream smoke from different cigarette brands in Japan. *Environ Health Prev Med*. 2018 Apr 27;23(1):15. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29703135>

Jeffery, J, Carradus, M, Songin, K, Pettit, M, Pettit, K, Wright, C. Optimized method for determination of 16 FDA polycyclic aromatic hydrocarbons (PAHs) in mainstream cigarette smoke by gas chromatography-mass spectrometry. *Chem Cent J*. 2018 Mar 13;12(1):27. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29536204>

Pickworth, W, Rosenberry, ZR, Yi, D, Pitts, E, Lord-Adem, W, Koszowski, B. Cigarillo and Little Cigar Mainstream Smoke Constituents from Replicated Human Smoking. *Chem Res Toxicol*, 2018. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29582659>

Bagchi, P, Geldner, N, deCastro, BR, De Jesus, VR, Park, SK, Blount, BC. Crotonaldehyde exposure in U.S. tobacco smokers and nonsmokers: NHANES 2005-2006 and 2011-2012. *Environ Res*. 2018 Feb 3;163:1-9. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29407484>

Hellinghausen, G, Roy, D, Wang, Y, Lee, JT, Lopez, DA, Weatherly, CA, Armstrong, DW. A comprehensive methodology for the chiral separation of 40 tobacco alkaloids and their carcinogenic E/Z-(R,S)-tobacco-specific nitrosamine metabolites. *Talanta*. 2018 May 1;181:132-141. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29426492>

Pack, EC, Jang, DY, Kim, HS, Lee, SH, Kim, HY, Song, SH, Cho, HS, Kwon, KH, Park, KH, Lim, KM, Choi, DW. Mixture risk assessment of selected mainstream cigarette smoke constituents generated from low-yield cigarettes in South Korean smokers. *Regul Toxicol Pharmacol*. 2018 Jan 31;94:152-162. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29408505>

Mendel, JR, Baig, SA, Hall, MG, Jeong, M, Byron, MJ, Morgan, JC, Noar, SM, Ribisl, KM, Brewer, NT. Brand switching and toxic chemicals in cigarette smoke: A national study. *PLoS One*. 2018 Jan 11;13(1):e0189928. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29324749>

tobaccoinaustralia.org.au

Tobacco in Australia

Facts & Issues

Zhang, S, Chen, H, Wang, A, Liu, Y, Hou, H, Hu, Q. Genotoxicity analysis of five particle matter toxicants from cigarette smoke based on gammaH2AX assay combined with Hill/Two-component model. *Environ Toxicol Pharmacol*. 2018 Jan 5;58:131-140. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/29329021>

Jain, VM, Karibasappa, GN, Dodamani, AS, Mali, GV. Estimating the carbohydrate content of various forms of tobacco by phenol-sulfuric acid method. *J Educ Health Promot*. 2017 Oct 4;6:90. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29109965>

Jebet, A, Kibet, J, Ombaka, L, Kinyanjui, T. Surface bound radicals, char yield and particulate size from the burning of tobacco cigarette. *Chem Cent J*. 2017 Aug 8;11(1):79. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/29086875>

Dethloff, O, Mueller, C, Cahours, X, Colard, S. Cigar burning under different smoking intensities and effects on emissions. *Regul Toxicol Pharmacol*. 2017 Oct 23. pii: S0273-2300(17)30328-8. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29074275>

Goel, R, Trushin, N, Reilly, SM, Bitzer, Z, Muscat, J, Foulds, J, Richie, JP. A survey of nicotine yields in small cigar smoke: influence of cigar design and smoking regimens. *Nicotine Tob Res*, 2017. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/29059441>

Savareear, B, Brokl, M, Wright, C, Focant, JF. Thermal desorption comprehensive two-dimensional gas chromatography coupled to time of flight mass spectrometry for vapour phase mainstream tobacco smoke analysis. *J Chromatogr A*. 2017 Oct 6. pii: S0021-9673(17)31497-8. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/29030031>

Koszowski, B, Rosenberry, ZR, Yi, D, Stewart, S, Pickworth, WB. Smoking Behavior and Smoke Constituents from Cigarillos and Little Cigars. *Tob Regul Sci*. 2017 Apr;3(Suppl 1):S31-S40. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/28944278>

Chae, C, Walters, MJ, Holman, MR. International Organization of Standardization (ISO) and Cambridge Filter Test (CFT) Smoking Regimen Data Comparisons in Tobacco Product Marketing Applications. *Tob Regul Sci*. 2017 Jul;3(3):258-265. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/28798947>

Wang, L, Cardenas, RB, Watson, C. An isotope dilution ultra high performance liquid chromatography-tandem mass spectrometry method for the simultaneous determination of sugars and humectants in tobacco products. *J Chromatogr A*. 2017 Sep 8;1514:95-102. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/28774712>

tobaccoinaustralia.org.au

Tobacco in Australia

Facts & Issues

Zhang, S, Chen, H, Wang, A, Liu, Y, Hou, H, Hu, Q. Assessment of genotoxicity of four volatile pollutants from cigarette smoke based on the in vitro gammaH2AX assay using high content screening. *Environ Toxicol Pharmacol*. 2017 Jul 18;55:30-36. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/28818740>

Ghaderi, A, NasehGhafoori, P, Rasouli-Azad, M, Sehat, M, Mehrzad, F, Nekuei, M, Aaseth, J, Banafshe, HR, Mehrpour, O. Examining of Thallium in Cigarette Smokers. *Biol Trace Elem Res*, 2017. Available from:

<https://www.ncbi.nlm.nih.gov/pubmed/28766107>

Ding, YS, Richter, P, Hearn, B, Zhang, L, Bravo, R, Yan, X, Perez, JJ, Chan, M, Hughes, J, Chen, P, Chen, W, Wong, J, Holmberg, S, Smith, S, Larango, M, Valentin-Blasini, L, Watson, CH. Chemical Characterization of Mainstream Smoke from SPECTRUM Variable Nicotine Research Cigarettes. *Tob Regul Sci*. 2017 Dec 1;3(1):81-94. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28220149>

Eldridge, AC, McAdam, KG, Betson, TR, Gama, MV, Proctor, CJ. Impact assessment of WHO TobReg proposals for mandated lowering of selected mainstream cigarette smoke toxicants. *Regul Toxicol Pharmacol*. 2017 Jun;86:332-348. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28284711>

Ghosh, A, Abdelwahab, SH, Reeber, SL, Reidel, B, Marklew, AJ, Garrison, AJ, Lee, S, Dang, H, Herring, AH, Glish, G L, Kesimer, M, Tarran, R. Little Cigars are More Toxic than Cigarettes and Uniquely Change the Airway Gene and Protein Expression. *Sci Rep*. 2017 Apr 27;7:46239. Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/28447619>

Goel, R, Bitzer, Z, Reilly, SM, Trushin, N, Foulds, J, Muscat, J, Liao, J, Elias, RJ, Richie, JP, Jr. Variation in Free Radical Yields from U.S. Marketed Cigarettes. *Chem Res Toxicol*. 2017 Apr 17;30(4):1038-1045. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28269983>

Leavens, EL, Driskill, LM, Molina, N, Eissenberg, T, Shihadeh, A, Brett, EI, Floyd, E, Wagener, TL. Comparison of a preferred versus non-preferred waterpipe tobacco flavour: subjective experience, smoking behaviour and toxicant exposure. *Tob Control*, 2017. Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/28381414>

Reilly, SM, Goel, R, Bitzer, Z, Elias, RJ, Foulds, J, Muscat, J, Richie, JP, Jr. Effects of Topography-Related Puff Parameters on Carbonyl Delivery in Mainstream Cigarette Smoke. *Chem Res Toxicol*, 2017. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28648066>

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Tobacco in Australia

Facts & Issues

Reilly, SM, Goel, R, Trushin, N, Elias, RJ, Foulds, J, Muscat, J, Liao, J, Richie, JP, Jr. Brand variation in oxidant production in mainstream cigarette smoke: Carbonyls and free radicals. *Food Chem Toxicol.* 2017 Aug;106(Pt A):147-154. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28528972>

Zuo, Y, Garg, PK, Nazih, R, Garg, S, Rose, JE, Murugesan, T, Mukhin, AG. A programmable smoke delivery device for PET imaging with cigarettes containing 11C-nicotine. *J Neurosci Methods.* 2017 May 1;283:55-61. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28347784>

Ding, YS, Richter, P, Hearn, B, Zhang, L, Bravo, R, Yan, X, Perez, JJ, Chan, M, Hughes, J, Chen, P, Chen, W, Wong, J, Holmberg, S, Smith, S, Larango, M, Valentin-Blasini, L, Watson, CH. Chemical Characterization of Mainstream Smoke from SPECTRUM Variable Nicotine Research Cigarettes. *Tob Regul Sci.* 2017 Dec 1;3(1):81-94. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28220149>

Saar, I. The effects of the lower ignition propensity cigarettes standard in Estonia: time-series analysis. *Inj Prev.* 2017 Feb 8. pii: injuryprev-2016-042187. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28179374>

Ren, Z, Nie, B, Liu, T, Yuan, F, Feng, F, Zhang, Y, Zhou, W, Xu, X, Yao, M, Zhang, F. Simultaneous determination of coumarin and its derivatives in tobacco products by liquid chromatography-tandem mass spectrometry. *Molecules.* 2016 Nov 10;21(11). pii: E1511. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/27834935>

Gellner, CA, Reynaga, DD, Leslie, FM. Cigarette smoke extract: a preclinical model of tobacco dependence. *Curr Protoc Neurosci.* 2016 Oct 3;77:9.54.1-9. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27696362>

Kurgat, C, Kibet, J, Cheplogoi, P. Molecular modeling of major tobacco alkaloids in mainstream cigarette smoke. *Chem Cent J.* 2016 Jul 15;10:43. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27429644>

Noguchi, M, Tanaka, S, Watanabe, K, Yamasaki, A. Correlation between odor concentration and Volatile Organic Compounds (VOC) composition of Environmental Tobacco Smoke (ETS). *Int J Environ Res Public Health.* 2016 Oct 9;13(10). Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27735848>

Mojska, H, Gielecinska, I, Cendrowski, A. Acrylamide content in cigarette mainstream smoke and estimation of exposure to acrylamide from tobacco smoke in Poland. *Ann Agric Environ Med.* 2016 Sep;23(3):456-61. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27660868>

tobaccoinaustralia.org.au

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Paschke, M, Hutzler, C, Henkler, F, Luch, A. Oxidative and inert pyrolysis on-line coupled to gas chromatography with mass spectrometric detection: On the pyrolysis products of tobacco additives. *Int J Hyg Environ Health*. 2016 Sep 4. pii: S1438-4639(16)30289-9. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27622657>

Wang, Y, Liu, M, Zhu, Y, Cheng, K, Da, Wu, Liu, B, Li, F. Identifying the tobacco related free radicals by UPCC-QTOF-MS with radical trapping method in mainstream cigarette smoke. Identifying the tobacco related free radicals by UPCC-QTOF-MS with radical trapping method in mainstream cigarette smoke. *Talanta*. 2016 Nov 1;160:106-12. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27591593>

Kant, N, Muller, R, Braun, M, Gerber, A, Groneberg, D. Particulate matter in second-hand smoke emitted from different cigarette sizes and types of the brand vogue mainly smoked by women. *Int J Environ Res Public Health*. 2016 Aug 8;13(8). Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27509517>

Serban, KA, Rezanian, S, Petrusca, DN, Poirier, C, Cao, D, Justice, MJ, Patel, M, Tsvetkova, I, Kamocki, K, Mikosz, A, Schweitzer, KS, Jacobson, S, Cardoso, A, Carlesso, N, Hubbard, WC, Kechris, K, Dragnea, B, Berdyshev, EV, McClintock, J, Petrache, I. Structural and functional characterization of endothelial microparticles released by cigarette smoke. *Sci Rep*. 2016 Aug 17;6:31596. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27530098>

Kurgat, C, Kibet, J, Cheplogoi, P. Molecular modeling of major tobacco alkaloids in mainstream cigarette smoke. *Chem Cent J*. 2016 Jul 15;10:43. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27429644>

Li, X. In vitro toxicity testing of cigarette smoke based on the air-liquid interface exposure: A review. *Toxicol In Vitro*. 2016 Jul 25. pii: S0887-2333(16)30148-5. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27470133>

Luo, YB, Chen, XJ, Zhang, HF, Jiang, XY, Li, X, Li, XY, Zhu, FP, Pang, YQ, Hou, HW. Simultaneous determination of polycyclic aromatic hydrocarbons and tobacco-specific N-nitrosamines in mainstream cigarette smoke using in-pipette-tip solid-phase extraction and on-line gel permeation chromatography-gas chromatography-tandem mass spectrometry. *J Chromatogr A*. 2016 Jul 8. pii: S0021-9673(16)30925-6. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27435688>

tobaccoinaustralia.org.au

Tobacco in Australia

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Watson, CV, Feng, J, Valentin-Blasini, L, Stanelle, R, Watson, CH. Method for the determination of ammonia in mainstream cigarette smoke using ion chromatography. PLoS One. 2016 Jul 14;11(7):e0159126. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27415766>

Higashi, T, Mai, Y, Mazaki, Y, Horinouchi, T, Miwa, S. A standardized method for the preparation of a gas phase extract of cigarette smoke. Biol Pharm Bull. 2016;39(6):898-902. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27251490>

Horinouchi, T, Higashi, T, Mazaki, Y, Miwa, S. Carbonyl compounds in the gas phase of cigarette mainstream smoke and their pharmacological properties. Biol Pharm Bull. 2016;39(6):909-14. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27251492>

Horiyama, S, Hatai, M, Takahashi, Y, Date, S, Masujima, T, Honda, C, Ichikawa, A, Yoshikawa, N, Nakamura, K, Kunitomo, M, Takayama, M. Intracellular metabolism of alpha,beta-unsaturated carbonyl compounds, acrolein, crotonaldehyde and methyl vinyl ketone, active toxicants in cigarette smoke: participation of glutathione conjugation ability and aldehyde-ketone sensitive reductase activity. Chem Pharm Bull (Tokyo). 2016;64(6):585-93. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27250793>

Horiyama, S, Kunitomo, M, Yoshikawa, N, Nakamura, K. Mass spectrometric approaches to the identification of potential ingredients in cigarette smoke causing cytotoxicity. Biol Pharm Bull. 2016;39(6):903-8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27251491>

Ishikawa, S, Kanemaru, Y, Nara, H, Erami, K, Nagata, Y. Assessing the mutagenic activities of smoke from different cigarettes in direct exposure experiments using the modified Ames Salmonella assay. Mutat Res Genet Toxicol Environ Mutagen. 2016 Jun;803-804:13-21. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27265375>

Tiwari, M, Sahu, SK, Bhangare, RC, Pandit, GG. Polonium in size fractionated mainstream cigarette smoke, predicted deposition and associated internal radiation dose. J Environ Radioact. 2016 Jun 10;162-163:251-257. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27294663>

Agnew-Heard, KA, Lancaster, VA, Bravo, R, Watson, CH, Walters, MJ, Holman, MR. Multivariate statistical analysis of cigarette design features influence on ISO TNCO yields. Chem Res Toxicol, 2016. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27222918>

tobaccoinaustralia.org.au

Tobacco in Australia

Facts & Issues

Pappas, RS, Halstead, MM, Watson, CH. Electron microscopic analysis of silicate and calcium particles in cigarette smoke tar. *Int J Respir Pulm Med*. 2016;3(1). Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27158665>

Jackson, KJ, Schroeder, MJ, Hoffman, AC. Mouth level exposure and similarity to machine-smoked constituent yields. *Tob Regul Sci*. 2016 Jan 1;2(1):3-8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27034970>

Pazo, DY, Moliere, F, Sampson, MM, Reese, CM, Agnew-Heard, KA, Walters, MJ, Holman, MR, Blount, BC, Watson, C, Chambers, DM. Mainstream smoke levels of volatile organic compounds in 50 US domestic cigarette brands smoked with the ISO and Canadian intense protocols. *Nicotine Tob Res*, Apr 2016. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27113015>

Perkins, KA, Kunkle, N, Michael, VC, Karelitz, JL, Donny, EC. Assessing discrimination of nicotine in humans via cigarette smoking. *Nicotine Tob Res*, 2016. [Epub ahead of print]. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27013335>

Ohkubo, T et al. Determination of polycyclic aromatic hydrocarbons and mutagenicity of mainstream smoke and heavy metals in tobacco filler of cigarettes of a brand in Japan and cigarettes of the same brand imported privately from other Asian countries. *Nihon Eiseigaku Zasshi*, 2016. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26832621>

Yang, Y et al. Rapid determination of the volatile components in tobacco by ultrasound-microwave synergistic extraction coupled to headspace solid-phase microextraction with gas chromatography with mass spectrometry. *J Sep Sci*, 2016. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26833965>

Gunduz, I et al. Tobacco-specific N-nitrosamines NNN and NNK levels in cigarette brands between 2000 and 2014. *Regul Toxicol Pharmacol*, 2016. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26806560>

Roemer, E et al. Heterocyclic aromatic amines and their contribution to the bacterial mutagenicity of the particulate phase of cigarette smoke. *Toxicol Lett*, 2016. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26724587>

Chagovets, V et al. Letter: Comparison of pyridine and pyrazine derivatives distributions in exhaled breath and exhaled breath condensate after smoking. *Eur J Mass Spectrom (Chichester, Eng)*, 2015. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26764312>

tobaccoinaustralia.org.au

Tobacco in Australia

Facts & Issues

Kim, HR et al. Comparative evaluation of the mutagenicity and genotoxicity of smoke condensate derived from Korean cigarettes. *Environ Health Toxicol*, 2015. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26796893>

Ding, YS et al. In-situ derivatization and quantification of seven carbonyls in cigarette mainstream smoke. *Chem Res Toxicol*, 2015. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26700249>

Uchiyama, S et al. Determination of nicotine, tar, volatile organic compounds and carbonyls in mainstream cigarette smoke using a glass filter and a sorbent cartridge followed by the two-phase/one-pot elution method with carbon disulfide and methanol. *J Chromatogr A*, 2015. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26653840>

Zhang, Y et al. Determination of benzo[a]pyrene in cigarette mainstream smoke by using mid-infrared spectroscopy associated with a novel chemometric algorithm. *Anal Chim Acta*, 2016. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26703252>

Zhang, J et al. Fully automated analysis of four tobacco-specific N-nitrosamines in mainstream cigarette smoke using two-dimensional online solid phase extraction combined with liquid chromatography-tandem mass spectrometry. *Talanta*, 2016. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26695255>

Klupinski, TP et al. Identification of new and distinctive exposures from little cigars. *Chem Res Toxicol*, 2015. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26605856>

Wang, X et al. Determination of nitroalkanes in mainstream cigarette smoke by heart-cutting multidimensional gas chromatography system coupled with mass spectrometry detection. *J Chromatogr A*, 2015. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26603996>

Li, X et al. Cytotoxicity and mutagenicity of sidestream cigarette smoke particulate matter of different particle sizes. *Environ Sci Pollut Res Int*, 2015. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26432262>

Rubio Armendariz, C et al. Heavy metals in cigarettes for sale in Spain. *Environ Res*, 2015. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26492401>

Hyodo, T et al. Five-year yield variation in N-nitrosornicotine and (4-methylnitrosoamino)-1-(3-pyridyl)-1-butanone from the smoke of commercial cigarette brands on the Japanese market. *Regul Toxicol Pharmacol*, 2015. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26382610>

tobaccoinaustralia.org.au

Tobacco in Australia

Facts & Issues

Pappas, RS et al. Triple quad-ICP-MS measurement of toxic metals in mainstream cigarette smoke from spectrum research cigarettes. *J Anal Toxicol*, 2015. Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/26359486>

Zhang, X et al. Quantification of 16 polycyclic aromatic hydrocarbons in cigarette smoke condensate using stable isotope dilution liquid chromatography with atmospheric-pressure photoionization tandem mass spectrometry. *J Sep Sci*, 2015., Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/26377484>

Mahernia, S et al. Determination of hydrogen cyanide concentration in mainstream smoke of tobacco products by polarography. *J Environ Health Sci Eng*, 2015. Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/26225214>

Marco, E, Grimalt, JO. A rapid method for the chromatographic analysis of volatile organic compounds in exhaled breath of tobacco cigarette and electronic cigarette smokers. *J Chromatogr A*, 2015. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26243705>

Gondal, MA et al. Determination of carcinogenic fluorine in cigarettes using pulsed UV laser-induced breakdown spectroscopy. *Applied Optics*, 2015. Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/26192861>

Vu, AT et al. Polycyclic aromatic hydrocarbons in the mainstream smoke of popular U.S. cigarettes. *Chemical Research in Toxicology*, 2015. Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/26158771>

Fresquez, MR et al. High-throughput determination of mercury in tobacco and mainstream smoke from little cigars. *Journal of Analytical Toxicology*, 2015. Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/26051388>

Gao, B et al. Parent, alkylated, and sulfur/oxygen-containing polycyclic aromatic hydrocarbons in mainstream smoke from 13 brands of Chinese cigarettes. *Environmental Science & Technology*, 2015. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26119395>

Lin, YH et al. Determination of nicotine in tobacco by chemometric optimization and cation-selective exhaustive injection in combination with sweeping-micellar electrokinetic chromatography. *Journal of analytical methods in chemistry*, 2015. Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/26101695>

tobaccoinaustralia.org.au

Tobacco in Australia

Facts & Issues

Morrissey, H et al. Constituents of smoke from cigarettes made from diverted nicotine replacement therapy patches. *Drug and Alcohol Review*, 2015. Jun 23, 2015. Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/26094737>

Forster, M et al. An experimental method to study emissions from heated tobacco between 100-200 degrees C. *Chemistry Central Journal*, 2015. Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/25941536>

Xiang, Z et al. Analysis of nitrogenous organic compounds from mainstream cigarette smoke using low-temperature solvent extraction followed by comprehensive two-dimensional gas chromatography with high-resolution time-of-flight mass spectrometry. *Journal of Separation Science*, 2015. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/25962488>

Corley, RA et al. Comparative risks of aldehyde constituents in cigarette smoke using transient computational fluid dynamics/physiologically based pharmacokinetic models of the rat and human respiratory tracts. *Toxicological Sciences*, 2015. Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/25858911>

Eldridge A, Betson TR, Gama MV, and McAdam K. Variation in tobacco and mainstream smoke toxicant yields from selected commercial cigarette products. *Regul Toxicol Pharmacol*, 2015.

Available from: <http://www.ncbi.nlm.nih.gov/pubmed/25620723>

Yan X, Zhang L, Hearn BA, Valentin-Blasini L, Polzin GM, et al. A High Throughput Method for Estimating Mouth-Level Intake of Mainstream Cigarette Smoke. *Nicotine Tob Res*, 2015. Available

from: <http://www.ncbi.nlm.nih.gov/pubmed/25649054>

News reports:

Bevan, L. 7 Poisons You Consume Every Time You Smoke, and You Thought It's Just Tobacco. *The Epoch Times*, 2019. June 28, 2019. Available from: https://www.theepochtimes.com/7-poisons-you-consume-every-time-you-smoke-and-you-thought-its-just-tobacco_2975549.html

Food and Drug Administration (FDA). Chemicals in cigarettes: from plant to product to puff.

Department of Health and Human Services, 2017. Available from:

<https://www.fda.gov/TobaccoProducts/Labeling/ProductsIngredientsComponents/ucm535235.htm>

tobaccoinaustralia.org.au

Tobacco in Australia

Facts & Issues

Stein, Benjamin. NIST reference material helps assure accurate measurement of tobacco product constituents. Medical Xpress, 2016. Sept 12, 2016. Available from:

<http://medicalxpress.com/news/2016-09-nist-material-accurate-tobacco-product.html>

No authors listed. Action needed to standardize methods for the measurement of cigarette smoke constituents. Medical News Today, 2015. Feb 17, 2015. Available from:

<http://www.medicalnewstoday.com/releases/289479.php?tw>

tobaccoinaustralia.org.au