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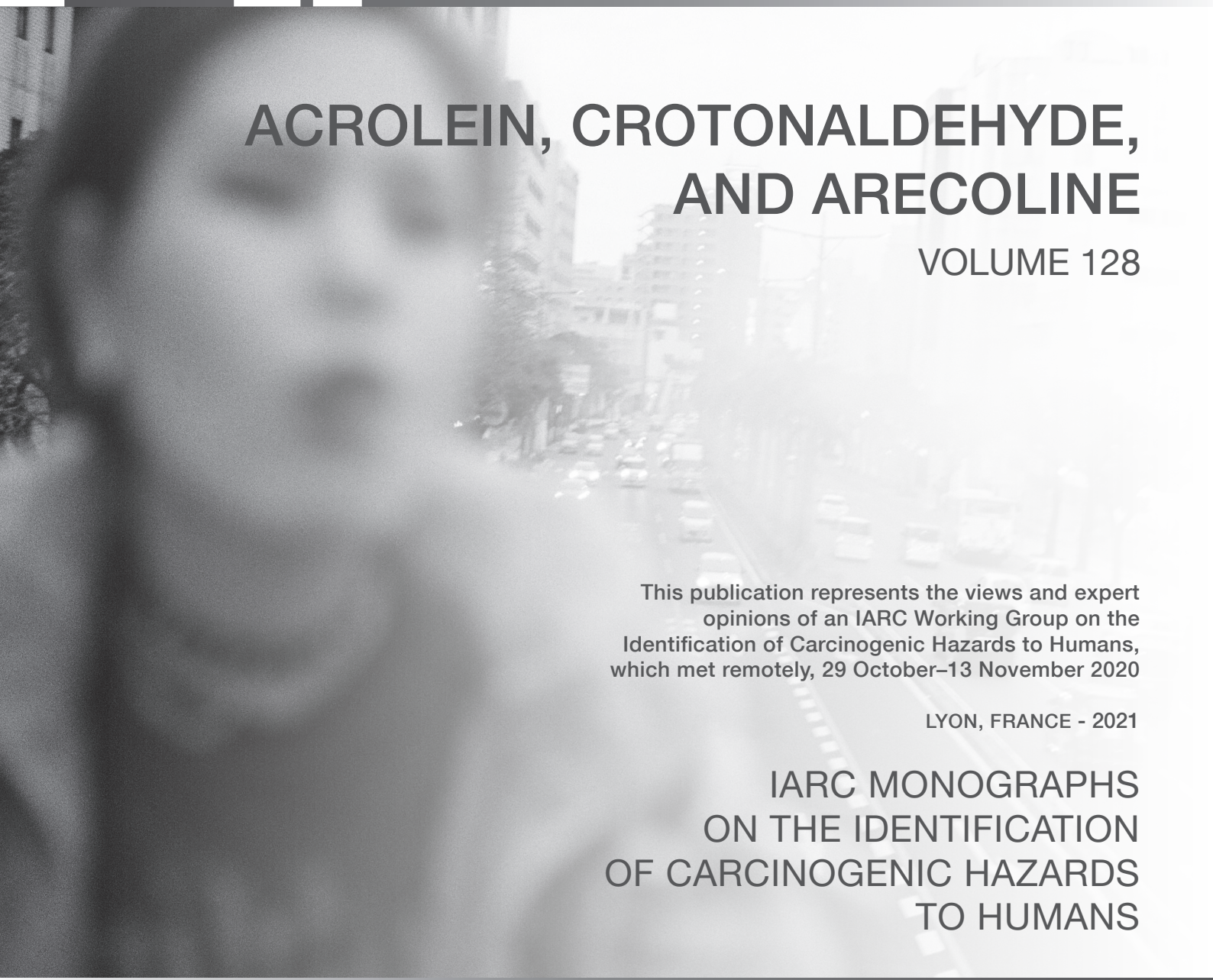

# ACROLEIN, CROTONALDEHYDE, AND ARECOLINE

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International Agency for Research on Cancer

World Health Organization

## Table S1.1 Representative methods for the analysis of acrolein

| Sample matrix | Assay procedure | Limit of detection | Reference |
|---|---|---|---|
| *Air* | | | |
| Indoor air samples | LC/MS | 3 ppb | Sakuragawa et al. (1999) |
| Ambient air samples | HRGC/ITMS | 0.91 ng/m$^3$ | Destaillats et al. (2002) |
| Diesel engine exhaust | HPLC/UV | 0.6–2.7 µg/L | Song et al. (2010) |
| Ship diesel engine exhaust samples | HPLC/UV and GC-MS-SIM | 6 ng/mL (GC/MS) | Reda et al. (2014) |
| Personal ambient and indoor air samples | HPLC/UV | < 0.5 ng/m$^3$ | Belloc-Santaliestra et al. (2015) |
| Indoor air samples | HPLC/UV | 0.012–0.056 ppm | Hsu et al. (2015) |
| Indoor air samples of newly produced coaches | HPLC/UV | 0.001 µg/mL | Lu et al. (2016) |
| Ambient air samples | HPLC/UV | 25–50 pptv | Stroud et al. (2016) |
| Indoor air and exhaled air | GC/MS | 2.88 µg/m$^3$ | Dias et al. (2017) |
| Indoor air and outdoor air | Thermo desorption GC/MS | 0.001 µg/m$^3$ | Scheepers et al. (2017) |
| Air samples inside family cars and public transport | UPLC/UV | 3.7–11.6 ng per tube | Xu et al. (2017) |
| Air samples | GC/FID | 0.01 µg/L (NTD-NPSA); 1.2 µg/L (NIOSH 2541) | Azari et al. (2017) |
| Indoor air samples from schools | GC/FID | 1.373 ppbv | Al-Awadi (2018) |
| Ambient air | FT-ICR-MS and UHPLC-MS | 0.07 µg/m$^3$ | Li et al. (2018) |
| Ambient air | GC-MS and GC/FID | 240 pptv | Gao et al. (2018) |
| Airborne particles | UPLC/MS-SIM | 0.8 µg/L | Melo Cardozo et al. (2020) |
| *Water* | | | |
| Water samples | GC/FID after sampling with a needle trap device | 0.03–0.1 µg/L | Barkhordari et al. (2017) |
| Environmental water samples | SPE-LC-MS/MS | 1.1 ng/L | Chiriac et al. (2019) |
| Drinking-water stored in polyethylene cisterns | HPLC/UV-Vis | 3 µg/L | de Oliveira Moura et al. (2019) |
| *Cigarettes and E-cigarettes* | | | |
| Cigarette sidestream smoke | PTR-MS and QCL-differential absorption | 2 ppbv | Knighton et al. (2007) |
| Mainstream cigarette smoke | HPLC/UV | 0.074 µg | Uchiyama et al. (2010) |
| Heated electronic cigarette solvents | HPLC/UV | 0.012 µg/mL | Wang et al. (2017) |
| Mainstream smoke from cigarettes | HPLC/UV | 0.67–1.07 µg/product | Cecil et al. (2017) |
| Heated tobacco product | HPLC/UV | 0.395 µg/collection | Farsalinos et al. (2018a) |
| E-cigarette aerosol | HPLC/UV | 1.0 µg/puff block | Farsalinos et al. (2018b) |
| Mainstream cigarette smoke | Headspace-GC/MS | 0.045 g/cigarette | Zhang et al. (2019) |
| Mainstream smoke from cigars and cigarettes | HPLC/UV | 0.267 µg/mL | Jablonski et al. (2019) |
| Electronic no-smoking aid refill solutions | HPLC/UV and GC-NPD | 0.06 µg/mL | Lee et al. (2020) |
| *Food and beverages* | | | |
| Heated vegetable oil | Headspace-GC-NPD | 20 pg/µL | Yasuhara & Shibamoto (1991) |
| Spirits and alcoholic beverages | Headspace-SPME-GC/ECD | 0.05–0.5 mg/L | Wardencki et al. (2003) |
| Heated vegetable oils | Ion-exclusion-HPLC with pulsed amperometric detection | 0.15 µM | Casella & Contursi (2004) |
| Cooking fumes of vegetable oils | GC/MS | 1 mg/m$^3$ | Fullana et al. (2004) |
| Raw spirits | Capillary isotachophoresis | 0.03 mg/dm$^3$ | Curylo & Wardencki (2005) |
| Spirits and vodkas | Headspace-SPME-GC/ECD | 0.016 µg/L | Sowinski et al. (2005) |
| Spirits and vodkas | GC/ECD | 0.0013 µg/dm$^3$ | Curylo & Wardencki (2006) |

**Table S1.1 Representative methods for the analysis of acrolein**

| Sample matrix | Assay procedure | Limit of detection | Reference |
|---|---|---|---|
| Calvados and cider | GC-NPD | 6–600 µg/L | Ledauphin et al. (2006) |
| Beer | Headspace-SPME-GC/MS | 1.2 µg/L | Saison et al. (2009) |
| French fries | SPME GC/MS | 0.84 ng/g | Osório & de Lourdes Cardeal (2011) |
| Potatoes fried with heat-processed fats | Headspace GC/MS | 15–20 µg/kg | Ewert et al. (2011) |
| Beverages | HS-SPME/GC–MS | 14 µg/g | Kächele et al. (2014) |
| Soybean oil during frying | UFLC-DAD-ESI-MS | 0.03–0.1 µg/mL | Bastos et al. (2017) |
| Wine | HS-SPME-GCxGC/TOF/MS | 1 µg/L | Lago et al. (2017) |
| Fish oil | LC-MS/MS | 2.5 ng/mL | Suh et al. (2017) |
| Samples from vinification process of Merlot wine | Headspace-SPME-GC/MS-SIM | < 1.5 µg/L | Ferreira et al. (2018) |
| Frying fumes | PTR-TOFMS | < 5 pptv | Majchrzak et al. (2018) |
| Beer samples | HS-SPME-GC/MS-SIM | 0.3 µg/L | Hernandes et al. (2019) |
| Fried clam | HPLC-MS/MS | 630 nM | Liu et al. (2020) |
| *Biological specimens* | | | |
| Human urine | Headspace-GC/MS | 56–280 ng/L | Sakura et al. (1998) |
| Human urine | Headspace-SPME-GC/MS | 1 nM | Takamoto et al. (2001) |
| Exhaled breath condensate | LC-APCI-MS/MS | 1.0 nM | Andreoli et al. (2003) |
| Human saliva | HPLC/UV and CE/UV | HPLC: 10 pmol<br>CE: 0.6 pmol | Annovazzi et al. (2004) |
| Human plasma | Fluorescence detection | 0.54 mM | Togashi et al. (2014) |
| Mouse plasma samples | LC-ESI-MS/MS | 1 fmol | Tomono et al. (2015) |
| Human exhaled breath | GC/FID | 0.01 ppm | Dwivedi et al. (2015) |
| Human serum | HPLC with fluorescence detection | 10 nM | Imazato et al. (2015) |
| Human urine | Headspace-GC/MS | 3 ng/µL | Serrano et al. (2016) |
| Urine samples | GC/FID after sampling with a needle trap device | 0.03–0.1 µg/L | Barkhordari et al. (2017) |
| Human serum | Headspace SPME/GC/HRMS | 2.16 µg/L | Silva et al. (2018) |

APCI, atmospheric pressure chemical ionization; CE, capillary electrophoresis; DAD, diode array detector; ELISA, enzyme linked immunosorbent assay; FD, fluorescence detection; FTIR, Fourier transform infrared spectroscopy; GC, gas chromatography; HPLC, high-performance liquid chromatography; HRMS, high-resolution mass spectrometry; LC, liquid chromatography; MLC, micellar liquid chromatography; MS-MS, tandem mass spectrometry; NIR, near infrared spectroscopy; NMR, nuclear magnetic resonance spectroscopy; NPD, nitrogen-phosphorous detector; ppbv, parts per billion volume; pptv, parts per trillion volume; SERS, surface enhanced Raman spectroscopy; SIM, selected ion monitoring; SPME, solid-phase microextraction; UFLC-DAD-ESI-MS, ultra fast liquid chromatography with diode array detector and coupled with electrospray ionization and mass spectrometry; UPLC, ultra-performance liquid chromatography; UV, ultraviolet; VIS, visual detection.

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