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Urinary PAH and Its Metabolites as Molecular Biomarkers of Asphalt Fume Exposure Characterized by Microflow LC Coupled to Hybrid Quadrupole Time-of-Flight Mass Spectrometry

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Prolonged, extensive exposure to asphalt fume has been associated with several adverse health effects. To study the molecular biomarkers of the effects, a microflow liquid chromatography (LC) coupled to hybrid quadrupole orthogonal acceleration time-of-flight mass spectrometry (Q-TOF MS) was used to develop a bioanalytical method to characterize benzo(a)pyrene and its hydroxy-metabolites from the urine of asphalt fume exposed rats. In the experiment, sixteen Sprague Dawley rats were exposed to asphalt fume in a whole body inhalation chamber for 10 days (4 h/day) and other eight rats were used as controls. The asphalt fume was generated at 150oC and the concentrations in the animal exposure chamber ranged 76-117 mg/m3. Benzo(a)pyrene and its metabolites of 3-hydroxybenzo(a)pyrene, benzo(a)pyrene-7,8-dihydrodiol(+/-), and benzo(a)pyrene-7,8,9,10-tetrahydrotetrol(+/-) were determined 2.19 ng/100 mL, 16.17 ng/100 mL, 6.28 ng/100 mL, and 29.35 ng/100 mL respectively from the urine of asphalt fume exposed rats. The results indicated that the benzo(a)pyrene and its hydroxy-metabolites in the urine of exposed rats were significantly higher than those from the control groups. The approach, which combined microflow LC separation and collision-induced dissociation for leading to a characteristic fragmentation pattern by hybrid Q-TOF MS, offered a distinct advantage for metabolites identification. The new method was sensitive, selective, and applicable toward the study molecular biomarkers of adverse health effects of occupationally related exposure to PAH hazards. The information obtained from these studies may assist prevent occupational illness by utilizing biomarkers of exposure to determine the need to eliminate or minimize exposure.

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