Novel Urinary Metabolites of Aldehydic Lipid Oxidation Products From Heated Soybean Oil Revealed by Aldehyde Abatement and Metabolomic Fingerprinting

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Objectives: Heated cooking oils are a constitutive component of contemporary human diets and a common ingredient in animal feed. Aldehydes, as the most reactive lipid oxidation products (LOPs) in heated oils, are widely considered as a contributor to the adverse health effect associated with heated oil consumption. Aldehydes-derived metabolites in biofluids are valuable for monitoring the exposure of the aldehydes from heated oils, but the efforts for their identification were hampered by the high reactivity of aldehydes as well as the chemical complexity caused by the coexistence of other LOPs in heated oils. To address this challenge, this study investigated the aldehydes-derived metabolites through the metabolomic fingerprinting of mouse urine samples from feeding heated oils with and without aldehyde abatement.

Methods: The heated soybean oil (HSO) was prepared by heating the control soybean oil (CSO) at 185°C for 6 h with constant air flow (50 ml/min). Both HSO and CSO were then mixed with the silica gel with piperazine side chain to remove their aldehyde content, producing the silica gel-treated HSO (HSO-si) and the silica gel-treated CSO (CSO-si), respectively. The urine, serum, fecal samples were collected from the C57BL/6 mice fed with 4 diets containing CSO, CSO-si, HSO, HSO-si, and then analyzed by the liquid chromatography-mass spectrometry (LC-MS) metabolomic analysis.

Results: The silica gel treatment dramatically reduced the aldehyde contents in HSO. Novel urinary metabolites formed by the reactions between 2,4-decadienal and lysine were identified through the metabolomic comparison between the HSO samples and the samples from 3 other treatment groups.

Conclusions: The identification of novel urinary metabolites of aldehydic LOPs warrants further biochemical examination on the chemical and metabolic processes responsible for their formation. These metabolites could become the biomarkers for monitoring the exposure of aldehydes in humans and animals.

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