Potential for Metabolomics-Based Markers of Exposure:
Encouraging Evidence from Studies using Model Organisms

Timothy Collette
US Environmental Protection Agency
National Exposure Research Laboratory, Athens, GA

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Genomic techniques (transcriptomics, proteomics, and metabolomics) have the potential to significantly improve the way chemical risk is managed in the 21st century. Indeed, a significant amount of research has been devoted to the use of these techniques to screen chemicals for hazardous effects. However, changes in transcripts, proteins, and endogenous metabolites may, in some cases, be more-certain indicators of chemical exposures than of apical chemical effects. Nonetheless, these powerful new techniques have rarely been applied as markers of exposure.

In comparison to (or in combination with) conventional biomarkers, genomic markers of exposure offer considerable promise. Note that genomic markers are a unique pattern of a large number and wide variety of transcript, protein, or endogenous metabolite changes. These signatures (or fingerprints) may be more informative and more chemical-specific than a conventional biomarker. Also, taking advantage of the earlier research in genomic markers for effects, these markers of exposure may, in some cases, be able to identify exposure to a specific mode-of-action-active chemical. Indeed, genomic markers can sometimes serve as a linkage across the source-to-outcome continuum, functioning concomitantly as markers of exposure, dose characterization, and effects.

Metabolomics may be a particularly powerful genomic tool for developing markers for both human and ecological exposures. For human exposures, it is important to note that metabolomics can be conducted effectively on biofluids that can be collected non-invasively from humans (e.g., urine, breath condensate, saliva) regardless of the ultimate disposition of the anthropogenic chemical. For ecological exposures, it is important to note that metabolomics can be conducted effectively without the need for a sequenced genome, and that metabolism is often conserved across species. We will illustrate here the advantages of metabolomics for developing markers of exposure, using results from studies with, e.g., fathead minnows, rodents and cell-cultures exposed to a variety of chemical stressors.

This abstract has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review policies and approved for presentation and publication.