Foodomics Analysis of a Mediterranean Diet Reveals Food-Specific Compounds That Are Detected in Human Plasma

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Objectives: Foods are comprised of thousands of compounds that may be absorbed upon ingestion. Metabolomics offers the unprecedented capability of measuring these small molecules to discover biomarkers of intake and examine how dietary patterns may exert their effects on health. The objectives of this study were to: 1) perform metabolomics analyses of 100 foods provided as part of a controlled feeding Mediterranean-style eating pattern (MED) intervention to identify food-specific compounds (FSC); and 2) determine which FSC were observed in participants' plasma samples.

Methods: Individuals (n = 41) completed a randomized, crossover, controlled feeding study with two five-week MED interventions separated by a four-week washout. Following extraction into lipid-rich and hydrophilic fractions, samples of 100 foods were analyzed in triplicate using liquid chromatography-mass spectrometry (LCMS). Participant plasma was collected pre- and post- each intervention period and similarly analyzed by LCMS. Food compounds were determined to be FSC if they were present in all replicates of a food but no other foods. Plasma data were assessed to determine presence of FSC. Analyses were completed using Mass Profiler Professional (MPP), and descriptive statistics were generated.

Results: A total of 1390 ± 1044 (mean ± SD, range 14–4908) compounds per food were detected. Ninety-nine foods contained FSC (mean 296 ± 393, range 1–2472) with 17% of all compounds unique to a given food. Feta cheese had the greatest number of FSC; pure maple syrup had the lowest. Ninety-six foods had at least one FSC detected in plasma (mean 28 ± 32, range 1–143) with 16% of all FSC found in plasma. Grape juice, apple juice, romaine lettuce, and peanuts each had one FSC in plasma, while salmon and beef had 143 and 76 FSC in plasma, respectively.

Conclusions: Metabolomics analyses of both foods and plasma confirmed that foods have compounds that are unique and that these unmetabolized compounds can be detected in plasma following consumption. This information can be used to identify food intake biomarkers and link specific components of eating patterns to health outcomes. Additional studies to examine reproducibility and determine dose-response will be vital to elucidating the relationship between food compounds within MED and health.

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