Combined LC-MS and ^{1}H-NMR metabolomic profiling uncovers dietary biomarkers in a cohort of healthy Northern Irish older adults:

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Abstract

A longstanding issue in the field of nutrition is the potential inaccuracy of methods traditionally used for dietary assessment (i.e. food diaries and food frequency questionnaires). It is possible to overcome the limitations and biases of these techniques by combining them with analytical measurements in human biofluids. Metabolomic technologies are gaining popularity as nutritional tools due to their capacity to measure metabolic responses to external stimuli, such as the ingestion of certain foods. This project performed both LC-MS and ^{1}H-NMR metabolomic profiling on serum samples collected as part of the NICOLA study (Northern Irish Cohort for the Longitudinal Study of Aging) in order to discover novel dietary biomarkers. A dietary validation cohort (NIDAS) was incorporated within NICOLA, involving 45 males and 50 females, aged 50 years and over. Participants provided detailed dietary data (4-day food diary) and blood samples at two time-points, six months apart. Serum samples were processed on two analytical platforms. ^{1}H-NMR spectra were acquired using a Bruker 600 MHz Ascent coupled to a TCI cryoprobe and processed using Bayesil (University of Alberta, Canada). A Waters TQ-S coupled with an Acquity I-class UPLC was used in combination with a targeted commercially available kit (AbsoluteIDQ p180 kit, Biocrates). Mass spectra obtained were processed with MetIDQ and verified using MassLynx (v4.1). Data were tested for normality, and metabolite concentrations were correlated with recorded dietary intake of each food type using SPSS. Additional tests (PCA, PLS-DA, ROC Curves) were performed on MetaboAnalyst 4.0 (University of Alberta, Canada). More than 50 statistically significant ($P < 0.05$) food-metabolite correlations were detected, 15 of which remained significant after eliminating potential confounding from sex, age and BMI. The strongest correlations were between fruit consumption and acetic acid, and between dairy consumption and certain glycerophospholipids (e.g. LysoPC aa C20:3). Stratifying the cohort by gender yielded further correlations, including PC ae C38:2 (dairy; males), PC aa C34:4 (dairy; females), PC aa C36:4 (dairy; females) and trans-4-Hydroxyproline (meat; males). A number of potential blood-based food biomarkers were detected, many of which are gender-specific, and some are corroborated by previously published studies. However, further validation work is required. For example, biological plausibility needs to be established, and the findings need to be reproduced in other cohorts to demonstrate their applicability in larger and more diverse populations. These results contribute greatly to the ongoing efforts to discover and validate reliable nutritional biomarkers as an objective and unbiased measurement of food intake.

Conflict of Interest

There is no conflict of interest.